

# UNIVERSITY OF TORONTO MEDICAL JOURNAL



DEATH

VOLUME XXXVIII

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## DEATH AND THE PHYSICIAN

A woodcut by Hans Holbein. The urine glass held by Death was once the symbol equivalent of the stethoscope. By the color of the urine, its odor and whatnot, the physician was able to prognosticate the fate of his patient. Death was academic even then.

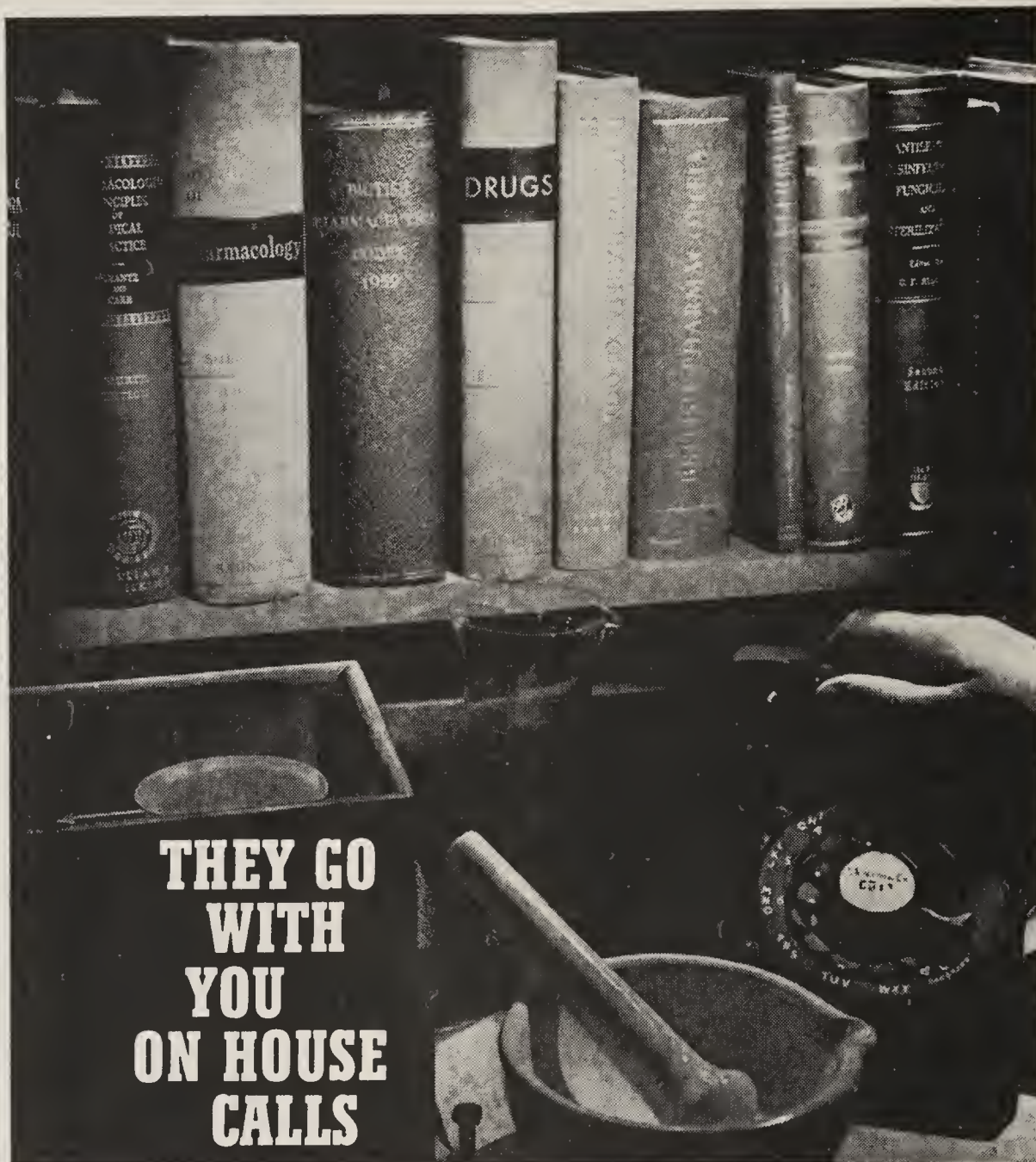
## THE COVER

From a woodcut dated 1495 A.D., our cover this issue reflects the attitude to death in another time and circumstance. It is a medieval death dance. In an age when plagues, pestilences and puerperal fever carried off even the hardy in numbers exceeding modern traffic tolls, one might expect the graphists of the era to be little preoccupied with the subject of death. In fact, they were to such an extent that they very often depicted the dead, as in this woodcut, doing things normally given to living people. Somehow it seems unreasonable for the twentieth century, having gained such a foothold, to live a life so naively devoted to immortality that he blows a hole in his duodenum and exsanguinates.

L.E.S.

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# UNIVERSITY OF TORONTO MEDICAL JOURNAL



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Volume XXXVIII

A D V E R T I S I N G

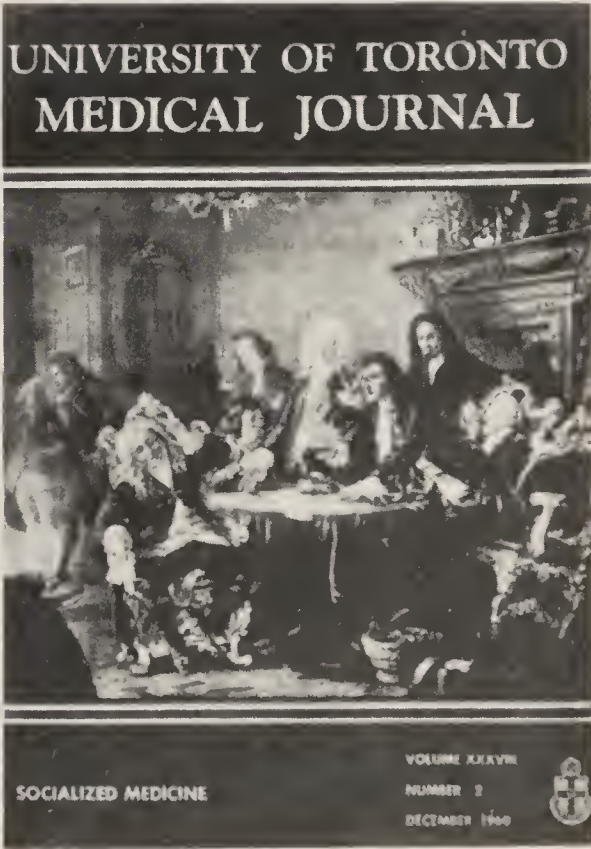


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## EDITORIAL

*Does it sting? Does it have an ugly head? Is it natural? Was it instantaneous? Does it have a shadow? Can a mistake be buried?*

As a taboo which is both feared and sacred, the subject of death enjoys a double immunity to enquiry from our society. The thought of Life without Me is repressed by all, doctors included. Our patients *die* and our relatives *pass on* while we, ourselves, are reincarnated in our eldest sons.

It is not to disturb this "homeostasis" that we endeavour to study phenomena of death, for it can be said that ignorance in some cases produces less anxiety than awareness. Whatever our status-right as plain human beings not to think in terms of non-being, our lot as a profession is an intimate one with dying and the dead. It follows that we be cognizant and understanding of the "gruesome" constituents of demise. Plato would argue this with the analogy that a policeman need not spend time in prison before sending a felon there for his just reward. However, we think that such would help the future wrong-doer just as a study of death will help tomorrow's dier.

### KUDO

On the Masthead page this issue a composite picture of the Journal staff is shown. This was done for us by our photographer and illustrator, Robert Gilder, who does similar work for the Princess Margaret Hospital, Toronto. Five years ago during the course of the second Physiology lab. in the first Medical year, Bob sold me his almost new lab. manual for 75 cents, turned in his A.T.L. card, and took up his hobby professionally. Our admiration for such bravery is only exceeded by that which we have for the work he has turned out since, particularly that published in this journal this year. He has given us the fulfillment of our wish to have illustrations and photographs throughout our pages, all without cost to the needy.

This issue, R. S. Gilder writes on a subject dear to the hearts of photo-mad medical personnel. We wish to thank him for this as well as all of the numerous favours he has done us this year.

L. E. S.

### CIRCUM STANZAS

For the past four years the Department of Ancient Studies of the Faculty of Medicine has been busy piecing together and translating certain old Greek manuscripts. These were found in the "secrets cupboard" of an ancient and venerable Greek organization on St. George St., and were probably written about 100 years before the Christian era, at or near the Temple of Aesculapius, Athens.

Recently the Department released some fragments which are parts of a letter written by a Temple neophyte to his father in Corinth. While the first page is missing, and the rest of the text incomplete or too faint to translate, it offers the student of medical history a telling testament to the vast improvement which has been made in medical education in the last two thousand and fifty years, or so. It is not without considerable pride in this remarkable achievement that the Editors of the *University of Toronto Medical Journal* present the piece to their readers.

Included with the letter in what seemed to be an enclosure were two fragments on which were printed the incomprehensible words, "Be relevant. Write legibly". The letter itself read as follows:

"....are so bad that when some of my fellow neophytes (Ed.— from the Greek *neophytos* meaning lowly medical students) went to Alexandria to write the Egyptian boards, most of them flunked (Ed.— Greek *flunkos* meaning to go down) Evil Spiritology and Potion Making....so we formed a Priest — Neophyte committee to study the quality of instruction in the temple...when all the questionnaires were tabulated we took the results to the Chief Priests....few were interested.

"....and this year the worship of Apollo begins at sunrise....many of the neophytes commit blasphemy by remaining in their cells to worship Endymion. The Priests are able to ignore the inattendance only by going into holy trances ...one high Priest in particular, whose place is not far from the Temple, is able to say nothing in so many ways that even mother would be outdone".

"....so that after six years you would think we should be holy enough to make the marking of our notes unnecessary....I have a feeling that we are being trained as scribes, not Priests....it is a good thing that Hippocrates tells us not to do any cutting....our training is in the art of sending, not doing".

"....recently the head neophyte handed out application forms (Ed.— from the Greek *formos* meaning nuisance) for ordination. We have to send 5 drachmas to Corinth with the form and in return we get another form which we fill out and send to Sparta along with 150 drachmas! Some Temple is getting rich! ....after all, 18,000 *dms.* is one....of a lot of money to leech from poor neophytes!

"....For some time now the Grand Council of Priests has been concerned over the number of neophytes who go to Egypt for their junior priesthood. It is felt that Greece is getting a raw deal. (Although the Athens Generous Temple always seems to be swarming with ecclesiastical types). So what do you think? Right! They made a decree that all priests (on pain of excommunication) must spend a junior priesthood in a recognized Greek Temple....how chauvinistic!....strong objection to us having things better than they did".

"Well, that's all for now; give my best to my favorite slave,

Yours,

Giton.

The translators regret the many breaks in continuity and hope that in future more complete material will be found so that the reader will better understand the conditions of those times.

C.C.

*From The Styricon, by Petronius, about Rhetoricians*

"....How else can you account for all that wretched rant? ....No one would mind this claptrap if only it put our students on the road to real eloquence. But what with all these sham heroics and this stilted bombast you stuff their heads with, by the time your students set foot in court they talk as though they were living in another world. No, I tell you, we don't educate our children at school; we stultify them and then send them out into the world half-baked. And why? Because we keep them utterly ignorant of real life. The common experience is something they never see or hear.... What's more, if you'll pardon my bluntness, it was you rhetoricians who more than anyone else strangled true eloquence. By reducing everything to sound, you concocted this bloated puffpaste of petty drivel whose only real purpose is the pleasure of punning and the thrill of ambiguity.... But then, in our own time, that huge flatulent rhetoric of yours moved from Asia to Athens. Like a baleful star, it blighted the minds of the young; their talents shriveled at the very moment when they might have taken wind and gone on to greatness".

Agamemnon counters; "....After all, if the patients are lunatics, surely a little professional lunacy is almost mandatory in the doctor who deals with them. And unless we professors spout the sort of twaddle our students admire, we run the risk of being, in Cicero's phrase, 'left alone at our lecterns'."

## The Diseases and Casualties this Week.



|                                                                  |     |
|------------------------------------------------------------------|-----|
| <b>A</b> Positive                                                | 4   |
| Aged                                                             | 45  |
| Breeding                                                         | 1   |
| Broken legge                                                     | 1   |
| Broke her icull by a fall in the street at St. Mary VVool-church | 1   |
| Childbed                                                         | 28  |
| Chrisomes                                                        | 9   |
| Consumpuon                                                       | 126 |
| Convulsion                                                       | 89  |
| Cough                                                            | 1   |
| Dropne                                                           | 53  |
| Feaver                                                           | 348 |
| Flox and Small-pox                                               | 11  |
| Flux                                                             | 1   |
| Frighted                                                         | 2   |
| Gowt                                                             | 1   |
| Grief                                                            | 3   |
| Griping in the Guts                                              | 79  |
| Head-mould-Ahoc                                                  | 1   |
| Jannidies                                                        | 7   |

|           |         |     |
|-----------|---------|-----|
| Christned | Males   | 90  |
|           | Females | 81  |
|           | In all  | 171 |

|        |         |      |
|--------|---------|------|
| Buried | Males   | 2777 |
|        | Females | 2791 |
|        | In all  | 5568 |

Plague—4237

Increased in the Burials this Week — 249

Parishes clear of the Plague — 27      Parishes Infected — 103

|                         |      |
|-------------------------|------|
| Impossthume             | 18   |
| Infants                 | 22   |
| Kingsevil               | 4    |
| Lethargy                | 1    |
| Livergrown              | 1    |
| Meagrome                | 1    |
| Palsie                  | 1    |
| Plague                  | 4237 |
| Purples                 | 2    |
| Quinsie                 | 5    |
| Rickets                 | 23   |
| Rising of the Lights    | 18   |
| Rupture                 | 1    |
| Scurvy                  | 3    |
| Shingles                | 1    |
| Spotted Feaver          | 166  |
| Stillborn               | 4    |
| Stone                   | 2    |
| Stopping of the Stomach | 17   |
| Strangury               | 3    |
| Suddenly                | 2    |
| Surfeis                 | 74   |
| Teeth                   | 111  |
| Thrush                  | 6    |
| Tifick                  | 9    |
| Ulcer                   | 1    |
| Vomiting                | 10   |
| Winde                   | 4    |
| Wormes                  | 20   |

*The Assize of Bread set forth by Order of the Lord Mayor and Coors of Aldermen,  
A penny Wheaten Loaf to contain Nine Ounces and a half, and three  
half-penny White Loaves the like weight.*

THE BILL OF MORTALITY — Aug. 15—22, 1665.

Representing an early attempt at statistical analysis of the causes of death, these weekly bills were recorded by old women employed by the parish authorities to inspect the body at each death. Undoubtedly the fellow who died of lethargy was a final year medical student of the time.

*"With what strife and pains we come into the world we know not, but it is commonly no easy matter to get out of it". — Sir Thomas Browne.*

In 1858, at Boston, the hanging of a robust, 28 year-old man was witnessed by Drs. Clark, Ellis and Shaw. The hanging took place at 10 a.m. and it was reported that there was neither any struggling nor convulsion. The lungs and brain of this man were found to be normal. How, then, did death take place? Without doubt its primary cause was sudden syncope from emotion or excitation produced by the drop of seven or eight feet at the moment of hanging; while the body was still hanging, seven minutes from the commencement, the sounds of the heart could be heard at the rate of 100 per minute. Two minutes later the rate was 98, three minutes later only 60 and very feeble. In two more minutes the sounds had disappeared.

"At 10:25 a.m. the body was taken down. There was no more sound of the impulse of the heart; the face was purple, although a small space near the ear probably allowed the passage of blood. The tongue and the eyes did not protrude; the pupils were dilated. The rope had been applied just above the thyroid cartilage. At 10:40 a.m. the rope was untied, as well as the pinions which bound the arms to the sides. This done, the face and the body gradually became pale. The vertebral column had not been broken. There was no emission of semen, a fact in harmony with the absence of asphyxia and of lesions of the spinal cord.

"At 11:30 a.m. a regular pulsation was noticed in the right subclavian artery. On putting the ear close to the chest, one would make certain that this depended entirely on the heart, and a single beat could be heard 80 times per minute, regular and distinct and accompanied by a slight pulse. The thorax was then opened, a proceeding which did not excite any pulsatile movements. The right auricle was contracting and dilating with force and regularity.

'At 12 a.m. the number of pulsations was 40 per minute; at 1:45 p.m., 5 per minute. The spontaneous movements ceased at 2:45 p.m., and irritability persisted till 3:18 p.m., more than five hours after hanging'.

According to the dictionary definition accepted by the medico-legal experts, somatic death is defined as the "cessation of life". Absence of pulse,

respiration, ciliary reflexes, heart sounds, and bowel sounds, confirm the diagnosis. Furthermore, in sudden death as pronounced by ventricular fibrillation, the blood pressure falls to zero and characteristic ECG patterns form. Initially an ECG shows 5 or 6 deflections similar to those produced by ventricular extrasystoles, but occurring very close together; then the deflections become lower in height and more erratic in frequency and shape. Eventually, no electrical activity traceable to the ventricle is recorded, as the fibrillation is followed by ventricular standstill. An EEG is of no help at all as the EEG pattern may disappear to be replaced by a continuous flat line when there is cortical dysfunction. When it persists over the head for more than 10 seconds it is unlikely that any brain activity exists, and in such cases the damage is often irreversible. Localized areas of such flattening may also occur in cases where there is a large area of softening or an extensive surface tumour or clot lying between the cerebral cortex and the electrodes.

The definition does not necessarily imply that activity of the various organs and tissues cease simultaneously. Instead, in the dynamic process of death, vital phenomena are gradually replaced by cadaveric phenomena, the rate depending upon the viability of the tissue.

Sir William Osler wrote, "I have careful records of about five hundred death-beds, studied particularly with reference to the modes of death and the sensations of the dying. The latter alone concerns us here. Ninety suffered bodily pain and distress of one sort, another eleven showed mental apprehension, two positive terror, one expressed spiritual exultation, one bitter remorse. The great majority gave no sign one way or the other; like their birth, theirs was a sleep and a forgetting".

Just as the study of life for the pediatrician should begin with the infant *in utero*, so should the study of death begin with the events leading to it including the process of aging and the immediate circumstances preceeding death itself.

## AGING

The aging process begins before birth and continues throughout life; its rate varies with the individual and the tissue. There is a constant interplay of the forces of growth and of atrophy.

With advancing age, anatomical changes primarily those of atrophy occur in all the

body systems. The skin loses its elasticity and cutaneous glands; there are changes in its pigmentation, and lipid excretion; a loss of the rete pegs, and a consequent smoothing out of the dermo-epithelial junction, and the frequent occurrence of aberrant cells and hyperplastic lesions. Total skeletal bulk and strength decrease, but both the individual fibres and the interstitial connective tissue may increase. Myocardial muscle fibres become smaller while the pigment in their nuclei increase. Elastic tissue, particularly of the ventricle is increased. Arteriosclerosis itself may be a phenomenon of the normal aging process. Generally speaking, there is thinning of the gastrointestinal muscle and mucosa, general atrophy of lymphatic tissue, with the possible exception of that in the lung and decreased glandular function. Sensation becomes less acute; the brain lighter, the gyri narrowing and the sulci deepening; the leptomeninges become thin and adherent; the staining properties of neural nuclei change and the microglia and the oligodendrocytes proliferate.

Yet, few, if any, live long enough to die of aging alone. Selye writes, "I have never seen a man who died of old age. To die of old age would mean that all the organs of the body would be worn out proportionately, merely by having been used too long. Life, the biological chain that holds our parts together is only as strong as its weakest vital link.... But there is always one part which wears out first and weakens the whole human machinery merely because the other parts cannot function without it". Then what are these damaging forces and the weak links within the human framework?

### SUDDEN DEATH

The principle causes are trauma and diseases of the cardiovascular system. Instantaneous death may be due to ventricular fibrillation or standstill. Death within a few minutes of the onset of symptoms occurs with massive pulmonary embolism, and rupture of the heart or aorta. Death several hours after the beginning of symptoms may be the result of internal hemorrhage.

Other causes of death may be determined from the clinical symptoms. Intracerebral bleeding is accompanied by an abrupt loss of consciousness as its initial manifestation. Subarachnoid hemorrhage gives rise to a severe headache followed by a gradual loss of consciousness. Progressive decline in the blood pressure associated with increasing distension of the cervical veins and terminating in death in a few hours suggests seepage of blood into the pericardium. If the preceding symptoms are associated with a collapse of the neck veins there is hemorrhage

within the abdominal cavity. Myocardial infarction causes death within several hours of the onset of symptoms.

### MECHANISM

Regardless of the predisposing cause of death as outlined above, death is associated with some interference of the oxygen cycle, or rather with the functions of the organs which maintain the oxygen cycle. These organs are the medullary centres, respiratory organs, and the circulatory system. When the medullary centres are insulted, the respiratory movements cease and the oxygen cycle stops. A pure example of this type of interference is noted in cases of bulbar poliomyelitis. The oxygen cycle is damaged and death may ensue whenever the blood loses its oxygen carrying power either through loss of red blood corpuscles as in a hemorrhage from a chronic duodenal ulcer or through degeneration of erythrocytes as in severe anemia or by the formation of carboxyhemoglobin in carbon monoxide poisoning. The prevention of the oxygen interchange between air in the alveoli and the red blood cells in the pulmonary capillaries results in asphyxia and is a fairly frequent cause of death, for example, drowning. Moreover, death may be caused by the failure of the circulatory system to deliver sufficient blood to maintain the oxygen supply to the vital organs as illustrated in the case of sudden cardiac collapse resulting from extensive coronary artery disease. Accompanying the failure of the oxygen carrying mechanism and delivery, the body undergoes some gross changes.

### APPARENT DEATH

Activity does not entirely cease at the instant of death. The moment at which life ceases is difficult to determine. The fact that the dying man drew his "last breath" is no longer acceptable. This is well illustrated by apnea and cardiac arrest. Nor is the cessation of heart pulsations looked upon as the "finale" of life. Brouardel and Loye have demonstrated that when a dog is decapitated, movements of the heart persisted for 15, 20, or 25 minutes, but, also, that it was quite the same when the patient died of an internal hemorrhage. The Aztec Indians used to break the back of their captives in a ritual and offered the pulsating heart to their gods.

One can only speak of apparent death for when an individual dies, there is no interruption in the chemical processes which go on in his body. Metabolism continues energetically after death and, in certain infective diseases such as smallpox or rabies, to such a degree that the temperature of the body is raised from 2 to

## THE DYNAMICS OF DEATH

4 1/2°F. although the movements of the heart and respiration are arrested.

### INDEPENDENCE OF TISSUE FUNCTION

Bernard and Longet agreed in saying that the liver of a dead animal, placed on a table, retained its glycogenic function for some hours. Muscular excitability is known to persist for some time in an amputated limb. There are numerous illustrations of this phenomenon familiar to all.

Suspension of organic function during life is another point which will confuse the diagnosis of death. Experimentally in hibernating animals the functions of respiration and circulation are reduced to the minimum during winter sleep. If, while in this state, they are submitted to a reduction of temperature of 9 to 18°F. the vital phenomena already nearly imperceptible are absolutely arrested so that if an incision is made into the animal's paw there will be only a little oozing of blood. In tapping the heart there will be no contraction. However, if these same animals are warmed gradually for an hour to an increased temperature of 18°F. they will resume their vital functions suggesting that they were only in a state of apparent death. Certain hysterical states in humans present similar phenomena in which there is a temporary suspension and restoration of life.

It can be said that there are no signs sufficient to determine the moment of death with scientific certainty in all cases. Moreover, the uncertainty of the signs of death must be borne in mind. Thus in some cases an apparently stillborn child after prolonged efforts may be resuscitated by pulmonary insufflation up to three hours after the heart has ceased to beat. Other situations of apparent death are: hysterical persons, cataleptic trance, syncope or inhibition, accidental burial in sand permeable to air, submersion in water, hypothermia after exposure to cold, lightning and hydro-electric shock, head injuries, carbon monoxide poisoning, drunkenness, overdose of sedatives or anesthetics, convulsive toxins analogous in action to strychnine. Concerning premature burial, some diseases such as cholera are followed by post-mortem contortions and convulsions which may attain a considerable degree of force; displacement of limbs from this cause does not prove that a person has survived burial.

As a result of the outcry raised in France and Germany over the fear of premature burial in 1792, the so-called "mortuary chambers" were instituted. A person dies: he is carried to an apartment called the "mortuary chamber", where

he is surrounded with flowers, and a bell-rope is placed in his hand; as a bouble check, an attendant visits the place from time to time to inspect the corpse. There is no record of anyone having rung the bell since these were built.

On the other hand, the converse condition of apparent life in a dead body is not without interest and importance. The late Sir B. W. Richardson enumerated such conditions as are likely to be met with, and to give rise to doubt. Local or partial change of colour of the surface of the body to a bright red, for example, in a case of supposed scarlet fever. This is due to the oxidation of the blood by post-mortem interchange of gases. Retention of warmth from the arrest of the circulation in the cerebral centres persists after rigor mortis has set in. Muscular movements as in death from cholera are most often displayed in the right leg or hands, and may last for an hour. Retention of a lifelike expression is most often observed in children. Prolonged preservation sometimes results when decomposition is postponed by large and frequent doses of alcohol administered during the fatal illness.

### SIGNS OF DEATH

In the first few hours after death there are only negative signs. The abolition of the bodily functions is noted; intelligence is abolished, but so it is in syncope.

With the gradual failure of the respiratory system, normal breathing which should be quiet is replaced by noisy stertorous breathing in the comatose and dying patients. This is due to the vibrations of the soft tissues of the nasopharynx, larynx, and the cheeks. The "death rattle" combines with the bubbly noise produced by vibration of mucus in the trachea and the large bronchi. It must be pointed out that life may persist for a time though the respiratory movements are completely in abeyance as found in catalepsy, shock, or deep narcotism.

The lower jaw falls immediately after death, the persistence of which after rigor mortis sets in, is prevented by the application of a bandage around the head. This sign is not constant; death may take place with the jaw closed in tetanus, poisoning by strychnine, and hysteria.

### LOCAL CHANGES AT DEATH

The immediate decrease in tension of the eye at the moment of death is due to the cessation of circulation and the emptying of the vessels therein. Although this proves that the heart is not beating, it does not necessarily mean that the person is dead. The ocular tension, on the

other hand may persist in a drowned man owing to the imbibition and absorption of water. Occasionally the tension is increased with the eyeball being harder than normal. The iris undergoes modifications. During the death-struggle, and at the moment of death, the pupil dilates, even so as to disappear completely, then gradually returns to the normal midway position; as the eye loses more and more of its tension, the iris is thrown into folds. Bouchut has observed that atropine and eserine have no effect after death. A man dies with his eyes half shut, and if they are examined before they are closed completely, the conjunctiva and the sclera present a very characteristic brown hue.

In persons dying suddenly the eye preserves the impression of the objects which were in front of it just prior to terminal events. Photographs of the retina of a person supposed to have been murdered were shown to the Society of Legal Medicine in France in 1870. It is said that they reproduced the figures of a man and a dog in the act of springing and making the attack to which the individual had succumbed. These images were found to be extraordinarily vague, but when an experiment was done later, some of the photographs were very distinct. Kuhne of Heidelberg placed a grating in front of a rabbit, then killed the animal rapidly, removed its eye, exposed the retina, and photographed it. In print the transverse and the vertical bars of the grating could be recognized. However, since the retina must be photographed immediately after death, there is little possibility of this practice ever having a practical use in forensic medicine. It is unfortunate that only within the first twenty-four hours after death that a copy of the last scene of the final drama in a murdered man's life may be imprinted on the retina.

The face is plastic after death and as the facial muscles cool and contract they draw the face into many shapes. Sometimes the dead smile. They stare at you with glossy eyes and lolling tongues and dreadfully distorted visages. Occasionally, the outward appearance of life is preserved.

When the cervical part of the spinal cord is injured a little below the bulb, the individual so struck may preserve his attitude as if transformed into a statue. A French soldier was found during the war of 1870 sitting on the edge of a stream drinking out of his can. He had been beheaded by a cannon-ball; his lower jaw was disarticulated and hung down on his neck. Wounds of the cervical cord may induce complete rigidity of the corpse and stability in the position in which the wounded man occupied at the moment of his death.

Muscular immobility is attended with relaxation of the sphincters so that it is necessary to have nurses pack the rectum of the dead patient. Muscular contractility lasts for some time yet; then it disappears, and cannot be roused again even by means of an electrical stimulus. Electrical excitability lasts for some time after death, usually for a few hours or until rigor mortis occurs.

### GENERAL CHANGES

The first major change is *algor mortis* or the cooling of the body, which is accompanied by cessation of the circulation. Usually when a person dies, his body becomes cold at a definite rate. Taylor and Wilks in England have tried by observation to find the laws of cooling. They noticed that 6 or 8 hours after death the temperature varied from 60 to 80°F. and that 12 hours later, it varied from 56 to 79°F. In consideration of the body temperature one must take into account the environmental temperature, the disease causing death and the degree of protection of the body. In hemorrhage the cooling is rapid and in infective diseases such as cholera, tetanus, and smallpox there will be an initial rise in temperature at death.

The absence of the beats of the heart may be considered as a sign of apparent death, but not of real death. Venesection of a person newly dead yields no blood. Redness of transparent tissue under a strong light is a test of the presence of circulation. The explanation for this fact lies in the fact that when the individual dies, chemical processes continue; fermentation develops gases in the intestine, which, if the temperature is high, may acquire in twenty-four hours a tension of 1 1/2 atmospheres. Under the influence of this tension the diaphragm is pushed up as far as the third rib, and the blood in the heart and the great vessels and lungs is driven towards the periphery in the veins. It is actually a *post-humous circulation*. At the moment of death the skin is white. However, once putrefaction begins, the outline of the veins may be seen in blue under the skin and if venesection is then performed, blood escapes sometimes in abundance, though it will not coagulate.

*Dependent lividity* follows shortly. Blood by gravity flows into the dependent vessels which dilate due to the loss of muscular tone. In the lungs immediately after death there is little blood, but by the time autopsy is made several hours afterwards, blood has begun to accumulate therein and continues to increase for some time. In the skin the dependent parts are covered with violet patches called *cadaveric sugillations*. When these patches are sectioned it is seen that

the little capillary vessels of the skin are engorged with blood; if at the end of four or five hours, a fresh section is made, it will be evident not only that the veins contain blood, but also that the colouring matter of the blood has extended into the tissues due to post-mortem hemolysis. These patches of discolouration of the skin are difficult to mistake for an ecchymosis and are always present in the dependent parts. If death is not recent and the tissues are stained by the colouring matter of blood, the sugillations no longer shift their place. The patches of lividity do not always appear at the same moment; in persons who have died of hemorrhage they appear late and are only slight; on the other hand, they may appear before death in cholera, uremia, and asphyxia. In persons attacked with cholera, for example, the peripheral circulation has ceased. One investigator was unable to draw a single drop of blood from the radial artery of a cholera patient who lived for several hours longer. Lividity which appears before death is due to the stasis of blood, that is to gravitation and not to an alteration of the corpuscles.

Post-mortem clotting of blood occurs soon after death and this raises the problem of determining whether the intravascular clot formed ante-mortem or post-mortem.

In forensic medicine, stress has been laid on the difference between burns made during life and those made after death. During life, a burn produces a blister surrounded by a reddish areola and containing an albuminous liquid. When the blister breaks there is seen beneath it a network of small dilated vessels. When an individual dies at the moment he is burned, blisters are produced, but no congestion. In the dead body itself, a burn may cause a blister, but it will not form an areola.

### RIGOR MORTIS

When a person is dead, not much time should be wasted before covering the body with burial garments. Rigor mortis, as all nurses know, would soon make it impossible to put them on. This sign is not constant, and is often absent in still-born children and the fetus. It is generally agreed that rigor mortis is a nearly constant phenomenon in adults, but it may be so slightly marked in certain cases as to escape the notice of the most painstaking observer. The characteristic position of the lower limbs in extension and the upper limbs in semi-flexion with the hands clenched gives the "attitude of combat".

Often it is of extreme intensity; it is sometimes impossible to flex the thigh or the pelvis or to separate the jaws. Experimentally it has been demonstrated that there is violent contraction

during the production of rigidity which is so great that even without making extension, the muscle fibres are ruptured; it is a tearing of isolated bundles of fibres. Murderers sometimes try to take advantage of cadaveric rigidity by placing a knife or a revolver in the hand of their victim knowing it will close to give the impression of suicide.

Rigor mortis usually appears in the third to the tenth hour. In 1848, Brown-Sequard met with rigidity affecting the jaw in a patient suffering from typhoid fever a quarter of an hour before he died. Immediately afterwards, it spread over the whole body, but it disappeared at the end of thirty minutes and did not return. Following a severe fit of epilepsy or overdose of strychnine, rigor mortis follows immediately upon the phenomenon of contracture which existed at the time the patient died. On the average, rigor mortis lasts 24 to 48 hours with a range from a few hours to six or seven days. It is known that in exhausted individuals such as those dying of cancer or phthisis, rigor mortis appears early, but does not last long; on the contrary, in a person dying while in good health, it appears late, and is of long duration. Cadaveric rigidity appears first in the muscles of the lower jaw, then in those of the neck and eyelids, then the lower limbs, and lastly in the upper limbs. This order is not important. It disappears in the same sequence it began. Experience has shown that the muscles of the fingers will preserve their rigidity the longest.

Cadaveric rigidity appears early in the vesiculae seminales; the semen, owing to this contraction is discharged into the urethra and may escape externally, according to the position of the penis. When the man has died in good health, the spermatozoa contained in expelled semen may retain their movements for twenty-four hours. It has been reported that hanging a man by the neck usually results in priapism. In his account, Porter writes, "This fact has been little recorded in the literature, but a French army surgeon, Marcel Guyon, on the island of Martinique in 1823 witnessed 14 hangings in one day, and reported priapism at the moment of hanging and which persisted in a semi-erect position for at least one hour".

Rigor mortis can be found in other tissues. Particularly in the spleen, with its capacity for rapid enlargement and contraction, rigor mortis is well displayed. Rigidity of the dartos is also very plain. Rigidity of the muscles of the skin is of short duration and gives to this structure the appearance of "cutis anserina". Contraction of the diaphragm may be energetic causing an explosion of gas and often of liquids, or it may

be abrupt in which case they may evoke a hic-cough or sometimes an inarticulate sound or cry. Even the myocardium does not escape rigidity. When rigidity seizes the cardiac muscle, it contracts and expels the blood within its cavities and is in systole. As soon as the rigidity is gone, it is filled afresh because it has become distensible and it is then said to be in diastole. Harvey wrote, "I have several times opened the pericardium of a man within two hours after his execution by hanging, and before the colour had totally left his face, and in the presence of many witnesses, have demonstrated the right auricle of the heart and the lungs distended with blood, the auricle in particular of the size of a large man's fist, and so full of blood that it looked as if it would burst. This great distention, however, had disappeared the next day, the body having stiffened and become cold, and the blood had made its escape through various channels". In overwork, rigidity is precocious and brief and it may be added that putrefaction follows rapidly. Because of this fact coupled with gaseous infiltration of the whole body, butchers cut up their animals as soon as they are slaughtered so that they may be preserved for a tolerably long time in fresh condition.

As for the cause of rigor mortis, it was once thought due to the excessive production of "sarc-lactic acid", but recent work suggests that it is closely associated with a fall in ATP below a certain critical level. Rigor mortis begins much more rapidly if death occurs during severe muscular exertion, or following violent spasms or convulsions — a time when the ATP stores in the muscles are already low. Its gradual disappearance some 24 to 36 hours after death is probably attributable to softening of coagulated protein by autolytic ferments. The protein is probably myosin which is precipitated in the substance of the muscle.

#### PUTREFACTION

With the persistence of the chemical phenomena which take place in the human body after death, there is gradual self-digestion of all the tissues, the rate and extent depending upon the difference in tissue susceptibility. Its effect is to alter to a singular degree the appearances of the lesions resulting from disease or from wounds.

Pasteur demonstrated that organic material taken from a healthy animal and shielded from air did not putrefy. Putrefaction affects the body, therefore, in different ways according to whether it takes place in the open air, underground, underwater, or in a privy.

In this process, organic material undergoes changes to form inorganic material and eventually minerals. Aerobes, facultative anerobes, and

anerobes, fungi and insects, produce carbonic acid, hydrogen, nitrogen and amines. The quaternary of nitrogenized matters manifest a tendency to be transferred into tertiary or fatty substances, and these tend to return to binary compounds. A corpse placed in water after a certain time undergoes fatty degeneration and eventually assumes the appearance of a mummy because it will have borrowed from the water part of its mineral constituents. Therefore with specific temperature and environment, the degenerative changes vary.

When the body is exposed to the open air, putrefaction with autolysis is evident in the mucosal lining of the stomach, gall-bladder, and small intestine. Similarly, the brain and tubular epithelium of the kidney undergo rapid autolysis. The alimentary tract is more susceptible than the epidermis which resists the penetration of micro-organisms for a time. Duclaux, who studied the vibrios of the intestine demonstrated the part they played in putrefaction. At death they penetrate into the intestinal glands and come into contact with dead epithelium, destroy it, find their way into the veins and peritoneum, produce gases there and secrete diastase which liquifies the tissue. A stillborn infant and a child who dies within 24 hours post-partum show different changes. The stillborn has not breathed. On the other hand, in a child who has breathed, and who dies 24 hours after coming into the world, the phenomena of putrefaction are similar to those seen in the adult.

Our tissues contain oxygen and the quantity of oxygen favours the development of the aerobic colonies. But a person who dies of carbon monoxide asphyxia no longer contains much oxygen and the aerobes have difficulty in proliferating and in these cases the phenomenon is astonishing. When the Opera-Comique burnt down in Paris, it was observed upon removing the black and grimy smoke coating from the faces of two young girls that their complexions were rosy and lips red because the carbon monoxide had preserved the scarlet of the blood; even when putrefaction had set in, a few days afterwards, these girls still had a rosy look because the red blood was propelled towards the head and the face by the posthumous circulation. Another factor to consider is whether there was any food in the stomach at the time of death.

Grave-diggers sometimes think that they hear a noise in the graves three weeks after burial; this noise is due to the bursting of the abdominal wall distended by gas. The tension of the gas in the intestine would not in itself be sufficient to lead to the bursting of the belly, if the micro-

## THE DYNAMICS OF DEATH

organisms had not already liquified the tissues so as to diminish their resistance.

Depaul and Brouardel have observed pregnant women being delivered on the tables of the mortuary following their death during confinement or late pregnancy. The development of gas in the intestine may lead to the expulsion of the fetus, this being aided by a weakened uterus; it is a mechanical phenomenon of putrefaction. In one extraordinary instance the body of a woman was exhumed and a living child, who actually survived and grew up, was rescued from the coffin.

When the body putrefies in the water, the first green patch which appears does not show itself in the region of the cecum, as it does when the body putrefies in the open air, but over the sternum. During submersion, the water penetrates abundantly into the blood and this delays coagulation. Also, when the bodies of the drowned are withdrawn from the water, putrefaction takes place with extreme rapidity. Bodies more frequently undergo transformation into fatty matter in water than in the open air, and this is complete in five or six months. In water the phenomenon of putrefaction follows the same evolutionary course as that of fermentation within the intestine described previously.

The medico-legal expert in France is occasionally called to investigate putrefaction in bodies that have been thrown into a privy especially the bodies of new-born children. In the badly ventilated privy, decomposition goes on slowly under the urine and feces, but with adequate ventilation, putrefaction follows the same rapid course as in air.

### THE ORGANS

The sclerotic patch appears first in the eyeball. With the shrinking of the eyeball, the cornea and the sclera become wrinkled. The colour of the iris may be indistinguishable for 12 days or so during spring and autumn. The contents of the eye escape at the end of 2 or 3 months. Red froth escapes from the mouth and the nostrils.

A green patch appears on the skin over the region of the iliac fossa. Bullae of sanguinous fluid are noted in the epidermis. The nails become loose about the twentieth day in bodies exposed to the open air.

When the lungs of an adult begin to putrefy, their anterior and lateral surfaces become covered with blebs of gas. The lungs of an infant which has not breathed are never covered with blebs of gas. Posterior parts of the lung are the seat of well-marked hypostatic congestion. The colouring matter of the blood invades the par-

enchyma, then serum coloured by the same material effuses into the pleural cavities. The ciliated epithelium of the trachea retain their vibratile movements for 26 to 30 hours.

The liver changes into an alveolar mass filled with gas and floats on water. In the adult, brain putrefaction proceeds slowly but in the fetus and the new-born it is more rapid because the tissue contains more water. Bone lasts for a long time. The older a bone is, the lighter it becomes; it loses all its organic matter and becomes friable, but preserves its form. The uterus putrefies last.

### CADAVERIC ALKALOIDS

During the time that putrefaction is taking place a certain number of toxic products, cadaveric alkaloids, are produced in the interior of the organisms. These alkaloids found in the body after death are called *ptomaines*; those which are generated in the body before death are called *leucomaines*. Two classes of ptomaines exist: the first in which neurine predominates and whose action is convulsive; the second in which other substances are more abundant and which have a narcotic action. It should be noted that ptomaines produce exactly the same effects as strychnine and its salts, and secondly, certain toxic alkaloids (leucomaines) may be produced in the course of certain maladies such as in those patients who inhale the volatile products of cholera dejecta and in those who consume poor spirits of grain and potatoes.

Eventually, progressive dehydration, autolysis, and putrefaction cause total digestion of the soft tissues. With the use of prompt and effective refrigeration or fluid preservatives, deterioration may be delayed.

### SUMMARY

The diagnosis of death does not rest on a single criterion, but is established for certainty on a combination of signs. Absence of respiration or heart sounds is not sufficient for cessation of life. Aging does not parallel chronologic aging, but is dependent upon the stress of "wear and tear" to which it is subjected during life. Because the aging process is not uniform in all tissues, a breakdown occurs in the weakest tissue and contributes to the total breakdown of the body with death. Natural death is rare. Death is essentially due to a failure in the supply of oxygen to tissues, with a subsequent breakdown of the oxidative processes in the cells. Algor mortis takes place initially at a definite rate followed in 3 to 10 hours after death by rigor mortis. Cadaveric rigidity persists for 3 to 4 days and disappears

in the same sequence it began, from the head and neck to the lower extremities. Within the vascular system dependent lividity and post-mortem clotting of blood leads to discolouration of the tissues. Self-digestion of all the tissues of the body, augmented by putrefaction by intestinal bacteria terminates with lysis of the tissues. Eventually, all the organic material is reduced to the minerals from which it was formed. The body is now returned to the earth—but what of the soul?

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**ABSTRACT:** Management of Humeral Shaft Fractures: *B.F. Bryer*: Archives of Surgery, Vol. 81, Dec. 1960, pp. 914-28.

Treatment of uncomplicated humeral shaft fractures, regardless of site or type, by a hanging cast is preferable to skeletal traction or open reduction and fixation. However the cast must be light enough to prevent distraction (2 to 3 lbs.), must extend no more than one inch above the fracture site, must exert traction day and night, and must correct angulation and antero-posterior displacement. Shoulder and hand exercises are started within 24 to 48 hours, to be carried on every 2 hours. Since the humerus is a non weight-bearing extremity the cast may be removed within 6 weeks if clinical consolidation is demonstrated (with or without X-ray) to hasten rehabilitation. Skeletal traction may be used when the patient is confined to bed with multiple injuries or temporarily to achieve alignment. Secondary open operations give better results than primary open reduction.

Immediate operation for radial nerve palsy is not usually indicated since spontaneous partial or complete functional recovery after reduction is the rule.

**ABSTRACT:** The Adenoid Problem: *J. Lubart*: Archives of Pediatrics, Vol. 77, Dec. 1960, pp. 491-5.

The most common symptoms caused by adenoid hypertrophy are mouth-breathing (leading to facial deformities, crooked teeth, sinusitis, etc.), frequent respiratory infections, otitis media with otorrhoea, insomnia, rhinorrhoea, fetid breath, nasal twang to speech, eating difficulties, snoring respiration, anosmia, and mental dullness. While many children outgrow these symptoms, a good many suffer the chronic effects — catarrhal deafness and sinusitis. If the above symptoms due to adenoid enlargement not amenable to drug therapy are present, adenoidectomy (plus tonsillectomy where tonsil hypertrophy creates a local problem) should be done at any age from infancy onward.

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*"But man dies and is laid low;  
man breathes his last, and where is he?"*  
Job 14:10

"I am never born, nor do I die....."  
Avadhuta Gita 1:59

".....he who believes, has eternal life".  
John 6:41

"Every sould shall taste of death: and ye shall only receive  
your recompenses on the day of resurrection".  
Koran, Sura 3:180

"Weariness that wants to reach the ultimate with one leap,  
with one fatal leap, a poor ignorant weariness that does  
not want to want anymore: this created all gods and other  
worlds".

Thus Spoke Zarathustra 1:3

We all die. Death is one of the great universals  
of human experience, and what men think and  
feel about it in any century is relevant in any  
other. This article is a survey crossing geo-  
graphic and temporal barriers; it attempts to  
discover what attitudes men have had as they  
faced the ultimate human heritage.

According to Cicero, Pherecydes was the first  
to call the soul immortal. However, even the  
stone age Australian aborigine has some concept  
of immortality, and while not as sophisticated  
as that of Pherecydes, it serves to illustrate that  
such ideas belong to all levels of cultural attain-  
ment.

The interpretation of death begins with the  
observation of it. Man has always been close to  
death, and as he watched it steal his friends  
away, wondered. One moment the victim  
breathed, talked; the next moment he became  
still, gradually stiffened, and after a while, began  
to rot. The observer, whether Bushman, Aborig-  
ine, or modern European, seeks an answer.

The answers given have been many and  
varied. Some are simple statements; others,  
complex metaphysical systems. In some cultures  
belief is homogeneous; in others, class, sex or  
other distinction divides different bodies of belief.  
For the purposes of this discussion attitude will  
be taken to include both concept and affect; and  
the two, as far as is possible, will be discussed  
separately for reasons which will shortly become  
apparent.

## CONCEPTS OF DEATH

### Sleep

The physiological state most resembling death  
is sleep. It seems natural, then, that analogies  
be drawn linking these two, and that these become  
accepted popularly as fact. Reference to death as  
sleep is common in the Old Testament

"So man lies down and rises not again 'til the  
heavens are no more he will not wake or be roused  
out of his sleep".

Job 14:12

The idea of final resurrection and judgement  
on the "last day" was popular among the Jews  
in the first century before the Christian era, and  
this tradition exists intact in the Koran. The  
present day Jehovah's Witnesses consider that  
the consciousness is not "awakened" until the  
Day of Judgment, at which time

"....the trumpet will sound, and the dead will be  
raised up incorruptable, and we shall be changed".  
(1)

Paul expresses this view in his letters (see 1  
Corinthians 5:12-32, 1 Thessalonians 4:13-18)  
and it was popular in the early Christian church,  
at least in areas which were not under Greek  
influence.

Aristophanes shows us that while the idea of  
death as sleep occupied no significant role in the  
Hellenic world, analogies were drawn.

"For what is death but an eternal sleep"? (2)

In modern times we demonstrate at least some  
acceptance of this idea in our funeral rituals.  
"Rest in Peace" or its abbreviation "R.I.P." is now  
a worn-out headstone inscription. Funeral parl-  
our jargon includes such phrases as "slumber  
rooms". We see newspaper notices of death in  
which the body is said to be "resting" at such-  
and-such a funeral home.

The Mediterranean world in classical and  
early Christian times gives us much evidence of  
this belief. Specific references to sleep in epitaphs  
as well as admonitions the equivalent of "do not  
disturb" indicate a hope, if not a belief, that the  
occupant is sleeping.

## DEATH AND THE TRIBE

### *Soul-body Dualism*

While some regard death as sleep, it seems appropriate to many others to view it as a more unusual event. Here, death is seen as a separation between the body and *something else*, and that we may call, without metaphysical implication, a soul. The two together constituted a living person, but we are as yet unsure of the nature of the soul; whether it be material and natural or otherwise. Upon the answer to this question is based the view one may take of death and immortality.

In most pre-literate cultures the idea of a soul is a vague one. The soul is pictured as leaving the body at death, either to roam the earth, enter a new body, or go to a spirit-world. Death itself is often regarded as unnatural, that if sorcery had not been practised, physical immortality would be the natural state of affairs. Death by violence, obvious as in combat, or hidden as in magic, is thought to be the only possible one.

Some groups believe that at one time in the distant past all men were immortal. Certain Solomon Island people tell a story involving an old woman who symbolically represents the tribe. This woman forgot to shed her skin at the appropriate time and as a result became trapped in her body. Her soul was able to escape only at death. (3)

While disbelief in immortality was common in Greece at the time of Plato, *orphic* mysticism, which affirmed the immortality of the soul, was becoming increasingly popular in the form of cults which were replacing the older and materialistic Dionysian ones (4). The soul was conceived as immaterial and eternal, the body as material and mortal. This emphasis upon the non-material soul was intellectualized by Plato and, by devious routes, found its way into Christian theology altering to a marked degree the central concept of physical resurrection.

The present-day Roman Catholic concept of death contains both ideas. The soul leaves the body at death and is relegated to Heaven, purgatory, limbo, or hell. There it awaits the "last day" at which time the soul and body are recombined and judged.

The concept of death as the end of life, with no immortality of any sort, is rarely popular. The intellectuals of the west and the ascetics of the east have contributed a great deal to world literature, but the agnostics among them have had little influence on the belief of the people. We see that death is almost always given greater significance than simple observation permits and ideas of immortality belong not only to one

tradition but exist generally from primitive man to his civilized descendant.

### FEAR OF DEATH

To understand how a person feels about death, it is not enough that we know what he conceives it to be. For example; Christians have a joyful doctrine of "victory over death", but whence comes the fear that is such a real component of their attitude toward it? It may be argued that the "true Christian" has no such fear, but surely this is spurious if only because of the paucity of examples.

The fear of death (or the dead) is, in varying degrees, almost universal. Many primitive cultures fear ghosts and spirits (the surviving consciousness of a person who died), and have elaborate rituals designed to protect themselves from the hostile acts of the dead.

Tapirape tribesmen in central Brazil carry weapons during funerals to ward off the ghosts who have gathered to carry away the soul. The ghosts here are the souls of dead fellow tribesmen. Purification rites often follow these ceremonies. (5)

In like manner mourning customs of many groups seem less inspired by grief than by a desire to assure the soul of the "departed" that he was well regarded in life and is now missed in death, this to propitiate his wrath.

Tearing hair is a custom which enjoys remarkable vogue, being found in all levels of cultural achievement and widely spread in all continents. Some commentators speculate that the hair is a symbol of life due to its continued growing after death, and that this is why attention is focussed upon it in mourning ceremonies. The hair is shorn or pulled out by the roots, and custom often dictates each relative's duty in this regard (3). Considerably more moving are the mourning rituals of the Mafulu and Fiji islanders, who amputate fingers as a grand gesture to the dead. The number of persons and/or fingers involved depends upon the importance of the one who died. A story is told that upon the death of a king of Tonga one hundred fingers were ordered cut. But, the story adds, only sixty fingers were completely removed. Some other tribes burn themselves in the same cause, and much ingenuity has been displayed in the pursuit of macabre mutilations to appease the dead and exalt the living. The most extreme of course, are live burial of wives and retinue as in ancient Egypt; and Suttee, the practice in India before the British brought enlightenment, in which a wife of a prince threw herself on the funeral pyre. (3)

These practices stand out in marked contrast to the benign but highly functional ritual of the Andaman Islanders. Their funeral consists of a formalized reintegration of the social structure, disturbed temporarily by the death of one of its members. Here, property is redistributed according to kinship relations, and interpersonal relationships are adjusted. The concern is with the living and the departed spirits are largely ignored. (6)

Somewhat similar to these people are the Aivilik eskimos who categorically deny the reality of death, and profess no anxiety over the thought of personal demise. For them it is unforgivable for anyone to display emotion at the death-scene. A severely-ill woman will be huddled in the corner of a hut and were she to cry out at the prospect of dying, her husband would leave in disgust and shame. However in spite of this cavalier attitude, the same husband finds ghosts fearsome and buries the body quickly to avoid contamination or injury by the spirits. The death is then forgotten until a child is born which person is considered to be the reincarnation of the deceased, after whom the child is named. On one occasion two children were named after a great hunter who had died a short time previously. Both were considered to be the reborn hunter by their relatives and much competition between the two resulted to resolve the conflict. These people, because of their refusal to accept death as reality, are disturbed by Christian missionaries with their gospel of "victory over death" because of the implied reality of death. By affirming only eternal consciousness they avoid the anxiety surrounding it. (7)

Usually the corpse is an object of great dread. It is treated with respect and dispatched as soon as possible. It is notable however, that the Sulka sleep with the body for a few nights after death, apparently as a gesture of affection. Allen in his book *Evolution of The Idea of God* describes a New Guinea woman who kissed her dead husband's body every day until the skin dried up. Some African widows carry their husband's skulls with them at all times, these ornaments being viewed as the repository of the souls of the dead.

It is interesting to speculate on the cultural usefulness of death-fear. One can readily understand that a soldier who had absolutely no fear of death might be a fierce fighter albeit a reckless one. There may be a minimum amount of fear which is also optimum in keeping an army alive and yet effective. At the opposite end of this spectrum we can imagine the inefficiency of a society which devoted much of its time and energy in morbid preoccupation with death.

Certainly tomb building as a national past-time as in ancient Egypt would fit into this category.

Rare in primitive cultures is the use of fear of death to instill moral behavior. In these, the good and the evil are dealt with in the same way. As for advanced cultures, while only a fool would insist that moral behavior was the result of such intimidation, certainly the concern of men over their fate after death can and has been used as a powerful adjunct to moral leadership. (6)

Occasionally, in recorded history, there are events and circumstances in which the fear of death is either put aside or altered, and for reasons mostly conjectural, behavior in the face of death is strangely different from that which seems reasonable. One example, in which fear of pain appears to supervene over that of death is taken from the epitaph of a Greek physician near Rome, dated early in the Christian era.

"I saved many with drugs that freed them from pain and now my own body knows no pain in death. I, Nicomedes, am happy. I was not, and I became; I am not, and nothing hurts me". (4)

This epitaph occurs in different forms, but expressing the same sentiment, and has been found all over the Mediterranean world of the time.

The modern era has provided us with as striking an example of abnormal attitude to death as can be found. The reference here is to the abject lack of struggle evinced by the Jewish prisoners being herded into the death machines of the third Reich. We can only wonder and guess at the psychodynamics of this phenomenon. Thousands lined up waiting for certain death without significant objection, managed easily by relatively few armed guards. Whether they pretended to ignore their fate or were unable to care is difficult to know, but this is a horrible example of the malleability of the mind of man, when so deep-rooted an attitude as this can be transformed into total resignation.

The nature of the "average" American's attitude towards death has been the subject of enquiry by motivation analysts in an effort to devise more effective advertising techniques in the selling of life insurance and funeral services. In line with modern existentialist psychodynamic theory (see article on Psychodynamic Aspects) Dr. Ernest Dichter advised insurance companies to present life insurance as a method of perpetuating one's influence on the family and to avoid picturing any scene associated with death. (9)

The results of surveys done for a group of morticians indicated that most people are bivalent in their attitude to death and he uses the

## BOOK REVIEW

words "flight" and "fight" to describe these. Fight is evidenced in anger, grief, or frustration at the death scene, flight, by the use of such common euphemisms as "resting", "passed away", and by the attempts of funeral cosmeticians to imitate life in response to public demand. (8)

What does all this mean to us, people who deal with the living, not the dead? Only by a thorough understanding of our own attitudes towards death can we effectively deal with others facing it. And unless we are prepared to examine the answers and feelings of all men we will be unable to escape, even for a moment, our own cherished prejudices. It seems fitting to conclude with the epitaph of an old man, rich with life, regarding death with quiet equanimity.

"I looked on eighty-six years before I died and I leave my children's children under the sun. They are not vastly rich but of very high reputation. May they complete their lives as I did mine". (4)  
Greece, 200 B.C.

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ABSTRACT: Epilepsy and Television: C. Mawdsley; Lancet, Jan. 28, 1961.

It has been known since ancient times that flashing light could induce seizures in susceptible individuals. Roman slave dealers used to screen for epilepsy by rotating a potter's wheel before the eyes of the subject. Three cases are described in which grand mal seizures were induced while the individual was watching a flickering television screen. All of the subjects had striking EEG changes, and in two of them fits could be induced by means of a stroboscope. The patients were placed on anticonvulsants and were advised to refrain from watching television during episodes of faulty reception.

Resuscitation of the Newborn Infant: H. Abramson, M.D.; C.V. Mosby Co., 274 pages.

In 1957 various specialists in clinical and research work met as members of the Special Committee on Infant Mortality in New York. Their object was to consider the principles and practices of resuscitation of the newborn child. This book is an outgrowth of that meeting, all contributors being members of that committee.

Its basic concept is that the physiologic and biologic basis of respiratory difficulties of the fetus and neonate along with the known pathogenesis which may contribute to the prenatal distress need to be understood thoroughly before preventive measures to revive the infant are applied. The authors believe that an understanding of why anoxia and asphyxia occur in the infant is more important than a mechanical application of various resuscitation measures and apparatus. The greater part of the book is devoted to carrying out this principle.

The first section deals with the physiology, biochemistry and pathology of the fetus and newborn infants in relation to respiratory unsufficiency and includes a synopsis of the history and physical examination of the mother with obstetric diagnosis and management. A second part discusses the diagnosis of fetal distress and resuscitation procedures. (This section makes reference to the late Dr. Mann's apparatus). The last and most generally applicable section deals with the examination and appraisal of the infant, and is subdivided into a rapid preliminary examination in the nursery, including the various laboratory tests.

In spite of the necessary brevity, the book accomplishes its purpose: the advocacy of a *total* concept in the discussion of a given subject. The results of the laboratory worker are brought in and assimilated with the clinical data gathered by the obstetricians and pediatricians with the final objective of preventing prenatal disability and death.

Many of the newer aspects of physiological and biochemical responses to pregnancy, labour and delivery are not yet thoroughly understood — but what is known today, that which the practitioner can rely on, is summarized here.

A. H. G.

# DEATH AND THE INDIVIDUAL:— Psychodynamic Aspects

T. H. TULCHINSKY, 6T1.

*"Mors certa, hora incerta".*

With abrupt precision this laconic Latin phrase tells us of the universality of death, but it is this knowledge that we have to die that makes us human in distinction to the less ennobled brutes of this earth. Death as a phenomenon of life affects each of us as individuals, and therefore, whether consciously or not, each individual must in some measure make his peace with this certainty. Philosophies and religions throughout the ages have tried to help the individual over this hurdle, to come to terms with the inherent time limit to our existence. Psychology and psychiatry, as johnnie-come-latelies of the scientific world, and especially as studies of individuals, have made their contributions to helping the understanding of man's very individual passing-on. Some of the concepts of death that have come from these green fields, and some of the fruit they bear in the way of explanation of clinical events, are worthy of interest on our part as future participants in the drama of death, both as doctors, and as individuals. Space, time and orientation will permit only a cursory description of some of the fundamental psychiatric theories regarding Death, discussion of some studies of "the dying patient", grief, and theories related to suicide. By this discussion, we hope, the phenomena related to Death may be understood the better when seen in the light of the various psychiatric theories of Death.

## PSYCHODYNAMIC THEORIES

Religious faith notwithstanding, the death of a human involves Non-Being, in psychodynamic terms. Sigmund Freud, through his interpretative study of dreams, hysterical symptoms, and hypnotic phenomena, was able to show that mental forces and processes, of which one is unaware, are of great importance in the motivation of behaviour. In his earlier works, Freud postulated the life Force, Eros or Libido, which is the anabolic or creative force of the unconscious motivating man's creative urges, and manifesting itself in psychosexual behaviour, based on the pleasure satisfaction that the child secures from sense stimuli of special zones of his body, not only adult sexual urges focussed on the genital organs. In later works, especially "Beyond the Pleasure Principle", (10) Freud added a counter-balancing Death Wish or *Mor-*

*tido*, which is the catabolic self destructive basic urge of the unconscious mind.

As a premise in his explanations of the Forces in the unconscious mind Freud assumes the Pleasure Principle, whereby the conscious mind will take action to alter or redirect any situation which is causing an increase in unpleasurable tension to the unconscious mind. He modifies this principle by the added factors of self-preservative needs to alter this urge toward toad-like self-contentment into the Reality Principle. Instincts or Forces arising from the body and acting via the unconscious mind, are urges inherent in organic life to restore an earlier, therefore more pleasurable, state of being. So, as inorganic precedes organic, and non-being precedes being — then the aim of all life is death, and that the life of an organism is merely a necessary phase through which it must necessarily pass, striving towards its unconscious goal of death, in its own inherent way. The Libido, or sexual component of life is a pressure toward the prolongation of life, whereas the *Mortido* is the component pulling towards death.

Carl Jung enlarged upon this theory to say that man, the animal governed by instincts, (taking the form of legends) is controlled by the "law of the opposites", which was borrowed from the Yin and Yang of ancient Chinese philosophy. Here creation and destruction exist from the moment of birth: the beginning of death in the very spark of life — the two sides of the same coin.

Later critics of Freud deny the Death wish, but see *Mortido* as the *denouement*, or gradual catabolism of life. However they add *Destrudo*, the destructive urge in man, the wish to bring things to an end, as an instinct of the unconscious.

Recent years have seen the spread of the *Existentialist* philosophy into psychodynamic theory in which death is seen as a threat of Non-Being. Fear of death, or non-being, is a powerful motivating force in man's life, both for objective achievement, and for better definition of relationships with other humans. Death is a threat to man's self-awareness as an object, related to other objects in time, in space, in his own body boundaries, and to other human beings. (23) Thus death is but an extreme form of many threats to the identity of the individual. Man's identity is long and painful in the building; it is

largely a development of the love relationship of the child to his mother which permits the normal orientational perception of time, space and objects to develop for a given person. The fundamental security of the individual in his specific orientation pattern is threatened not only by death, but also in many psychoneurotic aberrations, when the "normal orientation" is not given the proper initial circumstances (and heredity?) in which to grow. (4)

### STUDIES ON DEATH

What has been learned about the psychodynamics of death from studies of patients? The literature is quite sparse (in actual studies) although discussions of individual cases are fairly common. The conclusions drawn in these "studies" closely reflect the school of psychiatric thought to which that particular author subscribes.

A recent Gallup poll of study (5) done by Canadian Facts Ltd., for the Toronto Telegram to provide material for a series of articles by Andrew MacFarlane in 1959, attempted to show attitudes toward death by a sample of the Canadian population. This study revealed that a majority of people sampled (62%) denied fear of death. Interest in the subject of death has always preoccupied theologians, philosophers, writers, psychologists and artists in spite of popular taboos on the subject. Studies have shown that even (or especially) dying people are interested in discussing death.

Dr. Daniel Cappon, of the University of Toronto, Department of Psychiatry, published (1959) a study of dying patients, (2) involving psychosocial histories and mental examinations resulting in diagnostic formulations of a group of patients experiencing the approach of near and inevitable death, compared to various other patient groups. Dr. Cappon concludes that but for fear of yielding the psychic ego to the great unknown, the thread of life would be cut sooner rather than later in abandonment to *mortido*. The catabolic death process of *mortido* is distinguished from the libido-perversion which produces positive death drives. The former, *Mortido*, is a theoretical construct, while destructive death drives are manifest clinically as pathological perversions of the life instinct. At the time of climax in dying, the two forces merge. There is no personality change in the period of dying. The dying patient cannot conceive of non-being; he may rationalize his departure as an ego defence. When the loose love-ties holding life together are dissolved and there remains but the narcissistic investment in the body itself, and this smitten by disease, the ties break and

the wish to live ebbs. Awareness of his fatal prognosis may then be a relief to the patient.

Another study (22) concludes that the certain knowledge of impending death clears the air for the patient to re-establish successful dependency relationships akin to the successful infancy. Writing and other forms of lasting achievement help the individual deny or defeat what Eissler calls "the problem of death in its full vastness and terribleness".

### GRIEF

*"Any man's death diminishes me, because I am involved in mankind; And therefore never send to know for whom the bell tolls; it tolls for thee". (6)*

This famous quotation from the English poet, John Donne, sums up the phenomenon of grief. One grieves for his friend, or relative because his own life is made the less rich by that loss. Or, as they say in the trade, the loss of loved, or even a hated one, introduces fear and dread into the heart, for one portion of our system of orientation as to time, place, object and person has been removed, and we are thereby moved one step closer to the dreadful void of non-being ourselves.

In the more classical analytic terminology, grief is an egocentric anxiety of separation in which the individual reveals his incompleteness by his fundamental need of the security of womb and family (especially mother) dependency. Death is a separation, and the mourner's hold in the world is challenged by it. The association of grief and ritual burial shows the latter as a relief for the living, not the dead one. We must have experience with what we have lost, before the loss becomes meaningful to us.

Normal grief is altered to a psychopathological level when the patient goes into a deep and prolonged depression. This occurs when the loss arouses a conflict within the mourner, as when he has had ambivalent feelings toward the dead person, so he blames himself for the hostility. The hostility the patient felt toward the dead person is then redirected toward himself, i.e., internalized, and the resulting conflict changes normal sadness to a pathological depression. (14)

The role of cultural determinants in our symbolization of grief are recorded in anthropological terms, and give us a great degree of understanding of the societies involved by the way they manifest this universal reaction—grief.

### PSYCHIATRIC DEATH SYNDROMES

#### *Suicide*

The subject of suicide provides an excellent

testing ground for the various theories of the psychodynamics of death. In his book, *Man Against Himself*, (14) Karl A. Menninger discusses suicide in essentially Freudian terms. Suicide consists of dying, killing, and being killed. It is very complex act whereas the popular assumption of a simple causal relationship is false. A man begins to commit suicide long before the final act. This act is determined either by some inherent constitutional variation, weakness or abnormality, or by acceleration or reinforcement of the destructive tendencies of the personality during the formative period of life. Self-defeating tendencies arose early in his life and strongly influence the whole course of his development in such a way as to overcome and finally conquer the benign life instinct. The conscious awareness of the wish to die — may or may not be present, as conscious motives cannot be relied upon to explain human behaviour.

Menninger states that the destructiveness in the world stems in large part from self destructive tendencies which are explainable by Freud's hypothesis of a death instinct, or primary impulse of destructiveness, as opposed to the life instinct, or primary impulse of creativeness. These creative and destructive tendencies, although initially self directed, become increasingly directed outwardly so that extraversion of aggressive tendencies is followed by extraversion of erotic or constructive tendencies to merge and, to a lesser or greater extent, to neutralize each other. When externalization becomes difficult, these become self directed again so that self destruction, the wish to kill or be killed, or erotic versions of these, occur. If there is only partial neutralization of these tendencies, various forms of partial or chronic self destruction occur. *Chronic Suicide* includes asceticism, martyrdom, neurotic invalidism, alcohol addiction, anti-social behaviour and psychoses. *Focal suicide* includes self-mutilation, malingering, polysurgery, purposive accidents, impotence and frigidity. If the self destructive impulse overpower the constructive ones, then successful suicide will occur. The primary aggressive wish to kill, the "hyperplasia of the super-ego" producing a wish to be killed, and the wish to die together produce suicide. These factors are influenced by external factors such as family, society, etc. Suicide is the end point in a chain of self destructive tendencies which appear long before the final act.

## SUMMARY

What is it that death tells us about life? Both the fundamental Psychoanalytic (Freudian) and

the Existentialist psychiatric (Threat of Non-Being) theories do more than postulate theories of man's unconscious attitudes to death. Each theory explains many manifestations of life, psychiatric syndromes, in terms of aberrations of the normal construction of the unconscious mind. Freud and his followers cannot attribute all psychic phenomena to the system maintaining processes, but also emphasize the disruptive processes they counteract. (1) Freud's theories arose from attempts to explain his clinical observations and he concluded that "Psycho-neuroses are based on a conflict between the ego instincts (i.e., death instincts) and the sexual instincts (libido or life force)". (2)

The Existentialist psychiatrists see the fear of death as fear of the threat of Non-being. The "normal" orientation of the individual is his relationships in time, in space to other objects and other people. These are the sum total of his life experience. Death is the destruction of this entire relationship, and therefore is fearsome because that which is beyond death is completely unknown. Yet man knows that he is mortal and therefore he must die, so he may counteract his certain fate of nothingness only by leaving behind him in the mortal world, things which are immortal — his seed in his children, the products of his genius and talent, the memory of his good will and good deeds. The fear of non-being is a basic aspect to all psychiatric disorder as well as a prime mover in stirring man's desire to achieve immortality in accomplishment.

Improvement of our knowledge of the psychodynamic aspects of death is perhaps the New Frontier (to use a currently politically popular phrase) in understanding the human mind. It threatens to become a popular topic if the number of magazine and newspaper articles, films, books on the subject are any index, perhaps to be to this generation what the discussion of sex was to the one following Freud's work earlier in this century.

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## A PRESCRIPTION PHARMACY DESIGNED TO MEET THE PHYSICIAN'S PROFESSIONAL NEEDS



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*"Show me the manner in which a people bury their dead and I shall measure with mathematical exactness, the degree of civilization attained by these people".*

So uttered Prime Minister Gladstone in England not so many years ago.

In our complex, highly organized society of today, Gladstone's criterion is well applicable. The crisis brought about by a death now, is a unique situation for almost everyone involved; a situation few are prepared for, either emotionally or physically. When death does occur, those involved are troubled not only with questions of how they should react to express their mourning but also what to do with the lifeless body and how to go about the many legal procedures that are necessarily involved.

Death inevitably brings a period of mourning, depending on the intimacy of relationship with the deceased. The memories, influences and shared experiences, seem now more intensely real than they were in life and, as a result, become more treasured and meaningful. This awareness of the common life together is, in itself, the cause of grief.

Most people pride themselves on their ability in this affluent community to conduct affairs of everyday business, whether it be the opportune buying and selling of stocks or merely the mechanical transaction at the local supermarket. But the shock of death affects these well-adapted individuals, the very fact of their mourning making it extremely difficult to countenance dealing with the mundane matters of death.

As a result, society now depends on a professional organization of morticians, undertakers, or more tastefully, funeral directors who have developed established procedures for handling the details. This has become the path of least resistance for those in emotional trauma. What was once a quiet, necessary service and solemn religious rite, is now a streamlined industry, a product of what one militant funeral parlour advertises as "the one purchase we must all make".

Reserved ads in the Toronto subway say "..... done with quiet simplicity; she would have liked it that way", while some American firms, engrossed in their highly competitive trade for business, state flatly on highway billboards that "We treat every woman like our sister. Every man like our brother or son. Female attendants". On mailed brochures, "Paste this number in your

telephone book. Service 24 hours a day. One phone call does everything".

One California funeral chain, in the best Madison Avenue tradition, is represented by a clock with no hands. The hands have been replaced by a swinging pendulum subtended by the legend chiseled into granite over the doorway "It's later than you think".

The funeral home emphasizes restoration of the body, a parting glimpse of the reconstructed face, an elaborate casket and funeral service, all of which seem to imply that the dead are not really dead at all. They are just "resting", sleeping safe from harm's way. As an indication of just how serious this aspect of their skill is involved, take as an extreme example, the funeral parlour in California that has skilled cosmeticians spend hours in discussion with the deceased's relatives over the exact dimensions of a smile or the precise angle the head is to be tilted. As a final touch, they will work from a colour photograph in a macabre example of art imitating art. Other technicians will discuss props that might be used. Anything from a favorite pipe clutched in the hand, to an engineer's hat perched jauntily on the head of a railroad tycoon helps to create the appropriate effects.

In days past, jewels, vestments, and food, pet animals and even servants were buried along with the dead for use in the next life. Originally meant solely for the benefit of the departing spirit, flowers now help to alleviate the grim reality of death, and florists certainly do nothing to discourage the tradition.

In ancient thinking, the activities of the dead were not confined to their own Valhalla. Revisitations to this terrestrial sphere were regarded as commonplace, Hallowe'en being a favorite date. Burying under heavy boulders and tombstones had a discouraging effect on these returning spirits or, failing this, suspected witches were burned to make doubly sure, — cremation and cannibalism being other equally effective alternate methods.

Concerning this former practice, cremation received a nineteenth century revival among religious reformers on both continents, who were alarmed at the persistence of pagan practices in their contemporary rites as well as the overloaded, enlarging cemeteries. It is interesting to note that a person to-day, does not own his body after death. Specific instructions of the deceased in his will, stating that he wishes to be

## DISPOSAL OF THE DEAD

cremated, are often ignored unless relatives see eye to eye on this matter. Some states in the U.S. require by law that all bodies be embalmed and placed in a casket for a minimum period of time at least. Whereas the law was good standard Public Health procedure previously, it is now medically unnecessary.

The cost of a standard funeral service has grown immensely in the last few decades, granted, as most other commodities too, but there has also been an evolution in the very nature of the business itself. Caskets with all the trimmings (carved oak, satin insets, and erosion resistant metal linings) simply can not be placed in the same class with grandfather's old pine coffin. For the shoot-the-works you-only-die-once crowd, some cemeteries have, at slightly extra cost, the luxury of tape-recordings playing the Loved One's favorite song for all eternity. The new breed of morticians tend to be in the professional consultant class, thus adding greatly to the total funeral cost. An oversupply, generally, of funeral establishments in the more populous areas, also helps to skyrocket fees.

Needless to say, the service rendered to-day is far more extensive than it has ever been. Approximately thirty separate services are at the disposal of the bereaved, such as looking after the death notices, settling insurance claims, legalizing death certificates, disposing of the body and, most important, helping to readjust the living to a society that has little time to countenance death.

Funerals are abandoning the churches in favour of the more streamlined funeral homes; another reason for increased cost. This past January, the Catholic Church of Canada asked undertakers to make "an agonizing reappraisal" of their profession, "not only of price structures but also of pagan customs and trappings that have crept into the industry".

Many of the problems brought on by a death seem to require immediate resolution, and it usually is most expedient to leave everything in the experienced hands of the funeral director. Because of the commercialism involved, it is still unfortunate that when expert counsel is most needed, impartial help is most difficult to obtain.

### LEGISLATION CONCERNING DEATH

#### *Duties of the Medical Practitioner*

The medical practitioner last in attendance upon a deceased, or if death has occurred without medical attendance, the coroner holding an inquest, is required to provide a certificate of the cause of death in the prescribed form in accordance with the provisions of the Vital Statistics Act of Ontario. It is further required that the

certificate be signed by the practitioner or coroner in question, and that no other person shall sign the certificate for him.

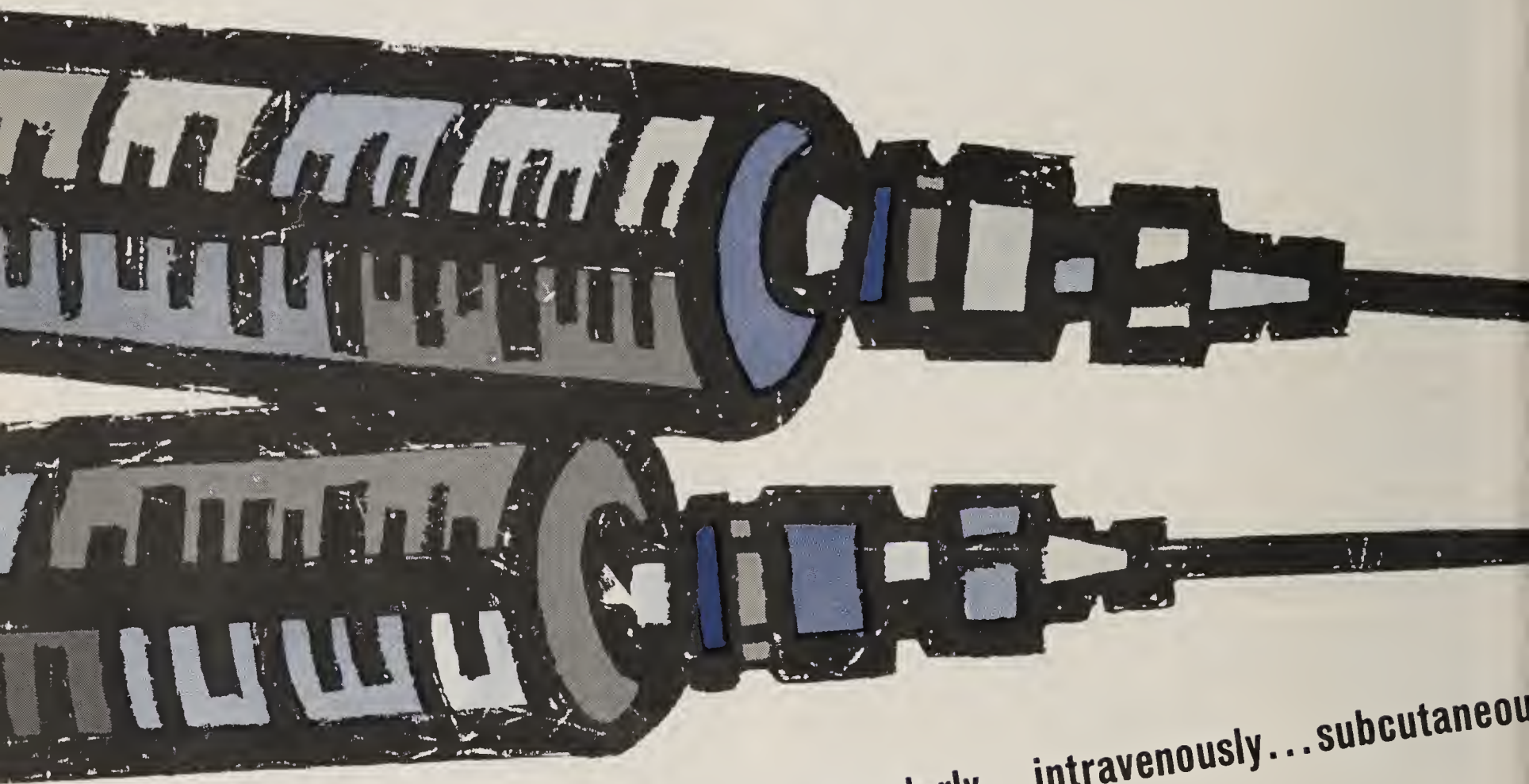
The statutes of Ontario also state that the doctor or coroner in attendance must sign the Medical Certificate of Death, and deliver this form completed as to the cause of death, to the undertaker or other person having charge of the body. Before a burial permit is issued, this death certificate must be completed.

The medical practitioner's responsibility is confined to the entries made on this certificate. However, there is an additional form that must be filled, called the "Statement of Death". This is a non-medical certificate that must be completed by the nearest relative present at the death or last illness. When there is no relative to act as the informant, the attending doctor may fill out the entire registration form. In the interests of statistical accuracy, as well as to ensure trustworthy legal records, it is important that the personal particulars recorded be correct. The interest of those concerned should be solicited to obtain complete and comprehensive data in all respects, especially in regard to the statement of residence, sex, racial origin, marital status, birth-place, age and occupation.

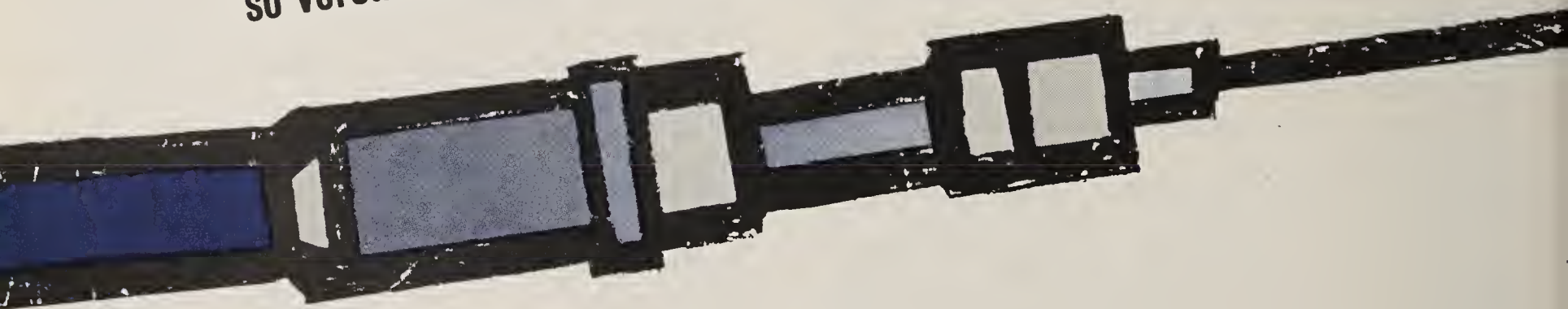
The revised medical certificate of death issued in 1935 has been retained in practically its original form. What is desired primarily, under the heading of "Cause of death", is a clear indication of the disease or injury which initiated the train of events leading to death. One important reason for the maintenance of these medical records is to direct attention to the point at which preventive measures may best be applied. While it is of value to know the number of people who had peritonitis at death, it is much more important clinically, to know what infection (such as appendicitis) produced this peritonitis. Practically all countries now prescribe a standard for classification of causes of death — the International List of Causes of Death. Besides ensuring practical agreement among countries in this fundamental of mortality statistics, the List aids the individual physician in avoiding ambiguous and misleading terminology. Such terms as "heart failure, asphyxia", etc., merely indicate the mode of dying and are, therefore, of little use to medical research, and should not be used.

*Procuring of Cadavers for Medical Schools*

The body of any person found publicly exposed or sent to a public morgue, is initially examined by the presiding coroner. He decides whether to hold an inquest depending on any evidence of violence, foul play or any unnatural incident leading to death. Unless such body is claimed within twenty-four hours by a relative



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CHLOROMYCETIN is also available in a variety of dosage forms for oral and topical use.

Chloramphenicol is a potent therapeutic agent and, because certain blood dyscrasias have been associated with its administration, it should not be used indiscriminately, or for minor infections. Furthermore, as with certain other drugs, adequate blood studies should be made when the patient requires prolonged or intermittent therapy.

*Medical literature available on request.*

*References:* (1) Ross, S.; Puig, J. R., & Zaremba, E. A.: *Antibiotics Annual* 5:803, 1958. (2) McCrumb, F. R., Jr.; Snyder, M. J., & Hicken, W. J.: *ibid.*, p. 837. (3) Payne, H. M., & Hackney, R. L., Jr.: *ibid.*, p. 821.

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or *bona fide* friend, it is delivered to the nearest medical school. The law requires that the body must be received by the teacher(s) of anatomy or surgery. The school must preserve the body for a minimum period of fourteen days during which time it may be claimed. It is the duty of the relative or friend who claims the body, to have it adequately interred or, upon the payment of a five dollar fee, cause the municipality in which the body was found, to inter it.

One interesting fact to note is that the method of disposal of the body is entirely within the hands of the claimant, regardless of any predilection by the deceased.

#### *Regulations Controlling Embalmers and Funeral Directors*

A five-man Board of Administration is set up for the purpose of overseeing the activities and practices of undertakers in Ontario. The Board also administers the School of Embalming and licenses the graduates under the direct authorization of the Minister of Health.

No one but a licensed embalmer can legally embalm a dead human body (with the exception of articulated students of embalming and students or staff of a medical school).

No body may be shipped outside Ontario unless it has previously been embalmed and adequately prepared for shipment, with a certificate of a qualified medical practitioner stating that the cause of death has been ascertained and there exists no other cause for inquiry or examination.

The Board may revoke the licence to practice of any licensee who is shown to be guilty of "infamous or disgraceful conduct". This is defined as personal conduct, economic management or advertising practice which would tend not to reflect credit on the profession nor to inspire confidence on the part of the funeral-purchasing public.

#### *Cremation*

In many European countries, cremation has replaced burying as the means of disposing of the dead. In Switzerland the whole procedure is

handled quite quietly and dispassionately by the state. Prince and pauper receive the same basic treatment — a simple memorial service (depending on the religion) followed almost immediately by cremation. Just recently in Toronto, a non-profit society called the "Toronto Memorial Society" was set up by the congregation of the South Peel Unitarian Church. For a cost of one hundred dollars, this organization handles a complete funeral. The body is cremated the same day as the memorial service, with no embalming or graveside commitment. There are no flowers and the body is not held on display. If burial is desired instead of cremation, the hundred dollar fee would be increased to about one hundred and fifty dollars (sixty dollars being the standard cremation rate at either of Toronto's two crematoria).

The Revised Statutes of Ontario stipulate a minimum period of 48 hours following death before cremation may take place. A coroner must view the body and assert that there were no irregularities surrounding the incidence of death. For the actual cremation, the body must be presented in a casket (minimum specification being seven-eighths inch pine). In the case of burial, no casket or embalming is required by law. As stated previously, the deceased's will has no legal bearing on his disposal after death. This is entirely in the hands of his executors or relatives who control his estate.

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**ABSTRACT:** Treatment of Acute Hyperkalemia Utilizing Extracorporeal Perfusion of Blood through Cation Exchange Resin Columns: *R.J. Moore et al*: Surgery, Gynecology and Obstetrics, Vol. 112, Jan. 1961, pp. 67-74.

Extracorporeal perfusion of blood through sodium cycle exchange resin for the treatment of acute hyperkalemia in renal failure has circumvented many of the disadvantages of the artificial

kidney. In both animal and human subjects E.C.G. and laboratory monitoring showed significant decrease in serum potassium levels to normal in 1-2 hours. Serum sodium rises only slowly, and replacement of calcium and magnesium removed by perfusion is necessary. Evaluation shows the process to be rapid, safe, efficient, and cheap, suggesting many new possibilities based on a resin column artificial kidney.

When a person dies, the funeral director may be called upon the scene in a number of ways. The usual occurrence is an elderly person dying at home after a more or less prolonged illness. Death has been anticipated and the family have gathered, in which case a close male relative is usually present. The funeral director receives a telephone call from this individual shortly after the event and, in this initial conversation, he elicits the full name of the deceased, the name, relationship and address of the person calling, and, if it is not the same, the address at which the body may be found. The funeral director must also know at this point if the doctor has filled out the Medical Certificate of Death. This has usually not been done; however, the doctor has left word at the home that the body may be removed and the certificate picked up later at his office. The funeral director is unable to remove the body without the Death Certificate or the Doctor's permission. Also during this conversation, a time, mutually agreeable, is set when the family can come to the funeral home to discuss the arrangements. This is usually accomplished the same day, or the next morning if the death occurs at night. In the situation where an individual dies leaving no relatives in the immediate vicinity, or where the relatives are women who may not be in control of themselves at the time, this initial contact is often made by a neighbour or the doctor.

The removal of the body is carried out as soon as possible, for obvious reasons. For example, sometimes the person has dropped dead in the bathroom, which is inconvenient, especially for the females and children of the family. If the funeral director does not have one of his own removal cars available at the moment, he will contact one of the Removal Services in the city who have cars and staff available which they rent out for this purpose. Thus the removal is usually effected, by one of these means, within the hour.

An important legal aspect involves the registration of the death and the obtaining of the Burial Permit, without which the body cannot be interred. This consists of securing the Medical Certificate of Death, which contains information as to the cause of death and is signed by the attending doctor, plus the Statement of Death which is a document containing the vital statistics of the deceased (name, age, sex, occupation,

marital status, birth place, parents' names, etc.), signed by the person giving the information, and by the funeral director. These documents are then taken to the city hall or any police station, where a Burial Permit is issued. This function was previously the family's responsibility, but it has now been taken over by the funeral director.

If the person calling informs the funeral director that the deceased had died in hospital twenty-four hours or more after admission, the sequence of events is slightly different from that described above. In the first place, the time element is not so important, as the hospital has facilities for handling the body without inconveniencing anyone. In addition, the funeral director coming to collect the body must have in his possession a Removal Permit authorizing him to take charge of the body and the personal effects of the deceased. Theoretically this permit should be signed by the relative in charge, however, as the form reads "authorized by" rather than "signed by", it is now customary for the funeral director to write in this person's name. Moreover, in a centre such as Toronto there is every possibility that the deceased was referred to the hospital in which death occurred, and the Medical Certificate of Death will be signed by an interne or resident, rather than the family physician.

The major difference when a person dies in hospital is the possibility that an autopsy will be performed. In the past, there has been a great deal of friction between the funeral director and the doctor over the performance of an autopsy, even to the point that funeral directors have advised families not to consent to the autopsy. There were a number of reasons for this deplorable situation, some due to the doctor's disregard, in his quest for the advancement of scientific knowledge, of the funeral director's function and responsibilities to a grieving family some due to the funeral director's lack of appreciation of the importance of a high percentage of autopsies to the medical profession.

For example, on being asked to consent to an autopsy, the family might have inquired how long it would take and been told that it could be done in a matter of hours. There is of course, time; however, no mention was made of when it was to be started. Thus, the funeral director, having informed the family that they would be

able to see the deceased at a certain time, would not be able to fulfill his obligation. Other difficulties arose from the purely technical aspect of the business. These included entering the skull via an incision difficult to conceal, soiling the hair with blood, severing vessels in such a position they would retract necessitating a lengthy dissection before they were available for the embalming procedure, and the removal of a finger on which the family expected to see a favourite ring displayed. Moreover, when an autopsy has been performed, each limb and the head must be embalmed separately, rather than the body as a whole by means of a single artery and vein, as will be explained later. This latter difficulty most funeral directors are willing to accept, however, and in some cases it may even be advantageous.

These problems have been dealt with in an amicable and satisfactory manner by the Hospital Relations Committee of the Funeral Director's Branch of the Board of Trade, so that relations at the present time are excellent. It is hoped that any future problems which arise in this field can be dealt with in a similar manner, so that progress is not needlessly blocked.

The other situation which is presented to the funeral director is the coroner's case. The coroner is automatically involved when a person dies in a public place, dies violently, or dies in hospital having been there less than twenty-four hours. In these cases it is the coroner's decision whether or not an autopsy is to be performed. When the coroner is called, he usually completes the death certificate immediately after his examination and leaves it so the funeral director can pick it up at the same time as the body.

When the body reaches the funeral home, after any of the above preliminaries, work is usually begun on it immediately. It is undressed, covered with a sheet and placed on the operating table. If the family does not want the clothing, it is cleaned and sent to an organization such as the Neighbourhood Workers.

The first step in the preparation of the body is the "setting of the features". The eyes are cleaned out and eye caps placed under the lids, so that the pressure of the embalming fluid does not force them open. The mouth is cleaned out, the dentures are placed and the mouth fastened closed, by means of sutures or a barb, in a natural manner. Cream is applied to the lips to keep them from cracking, and the nose is cleaned out. A light coating of cream is applied to the face to keep it soft and pliable and to facilitate the application of cosmetics. A male corpse will require shaving because the facial hair tends to

become more apparent as the skin contracts. This phenomenon gives rise to the false belief that a corpse must be shaved daily. The services of skilled hairdressers, made available by certain agencies, are enlisted in dealing with the problems of women's hair.

In preparing the features and applying cosmetics, as well as in the matter of hair-styling, the embalmer sometimes works from a recent picture of the deceased. When a person has died violently, or there is some defect involving the face, for example, a person dying of carcinoma of some part of the face who has undergone several radical operations, the coffin is usually closed, although some embalmers are skilled in the art of reconstructing features with Plaster of Paris, wax and cosmetics. This is entirely a matter of cost and the family's preference. In most cases the attitude of the family is that the person has been through enough, and they prefer to have the casket closed.

The actual process of embalming is begun as quickly as possible before clotting and post-mortem staining (discolouration of parts such as ear lobes due to the "settling" of the blood) occur and cause difficulties. The embalming fluid itself is a preservative-disinfectant prepared in concentrated form by highly specialized firms and made available to funeral directors. By law, it is required to meet certain specifications, for example it must contain no arsenic, in view of the possibility that foul play may become an issue and it becomes necessary to exhume and examine the body. A "cut down" is made on an artery and a vein, usually the carotid artery and the external (or internal) jugular vein, and an injection tube is inserted into the artery and a drainage tube into the vein. The axillary or femoral arteries may also be employed.

The injection tube is hooked up to the pressure embalming machine and embalming fluid is a concentration, harsh or soft, depending on the embalmer's preference, is forced in under pressure, replacing the blood. The drainage tube is connected to a container or led to the floor drain. The apparatus is allowed to run for a varying period of time, depending on the presence of discolouration, etc. Throughout the procedure the embalmer must keep a close watch in case a block develops, as the machine keeps forcing the fluid. Nine times out of ten the above method is satisfactory and the process is complete within half an hour. However if discolouration is present a set of vessels closer to the area may have to be selected, such as the radial artery in the case of the hand, and the fluid injected more directly. Also, if a block develops, the site of the

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1. Wolf, Olsen and Tyler: Obstetrics and Gynecology, Vol. 10, Sept., 1957.
2. Behne, D., et al: West. J. Surg., Vol. 64, March, 1956.

obstruction must be discovered, and steps taken to deal with it.

As mentioned previously, when an autopsy has been performed, each limb and the head must be injected separately. This is advantageous if obstruction occurs, as the site of obstruction can be rapidly localized. As the portal circulation is not dealt with by the method described above, the embalming process is not complete until a trochar has been inserted into the peritoneal cavity and embalming fluid injected. A properly embalmed body in a hermetically sealed casket will last almost indefinitely.

At the time previously arranged, which is preferably the same day as the death occurred, the family comes to the funeral home to make the funeral arrangements. The casket is chosen and the decision as to where and when the service is to be held (church or funeral home chapel) is made. The funeral director contacts the clergyman the family has chosen and confirms the arrangements as to time and place. Transportation for the deceased, the family party and the

clergy is the responsibility of the funeral director. The total cost of the funeral is usually the price listed on the casket. The funeral director's responsibilities end when he leaves the cemetery.

Cremation has increased in popularity in the past few years; the increase in the number of European peoples (where it has always been practised a great deal) in this country being largely responsible for this vogue. There are two crematories in Toronto, St. James Cemetery and Crematorium at Parliament and James, and the Toronto Necropolis and Crematorium on Winchester Street. Instead of being taken to the cemetery, the body is brought to the crematorium, a service is held in the crematorium chapel and the body is lowered through the floor. The ashes, in a suitably labelled cardboard box, or an urn if one has been provided, can be picked up in a few days.

ACKNOWLEDGMENT — The author wishes to thank Mr. J.R. Morris of John R. Morris Ltd., Funeral Directors, for his kindness in supplying the information for this article.

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Euthanasia (derived from the Greek *eu* meaning well and *thanatos* meaning death) is to-day synonymous with mercy-killing. Historically this has not always been so. Dr. Friedrich Marx in 1826 writes, "once they are convinced of the hopelessness of the patient's case, those whom God has given a nobler heart will just then, with no shining ray of hope remaining, consider it their more lofty duty to lay to peaceful rest a life they can no longer save. They will extend their energy and their affection so that the last breath of passing may be light and not dreadful to those left behind". (1) This in no way implies the object of precipitating death prematurely, but rather taking all actions necessary to permit naturally occurring death to be painless and untroubled. This original meaning is still implied to-day as one of our prime functions, that is, to relieve pain and suffering whether the hope of recovery is real or remote. Euthanasia means different things to different people. The word may be applied to the withholding of penicillin from a grossly incapacitated stroke victim who subsequently contracts pneumonia. It is definitely involved where any active step is taken to shorten a patient's life.

Various groups might be considered eligible for a merciful ending.

- (1) Those with intractable pain, an incurable disease, inevitable death being only a few days or weeks away.
- (2) Identical with group (1) except that inevitable death might be months to several years away.
- (3) Monsters, grossly physically deformed at birth, continuous nursing care being requisite.
- (4) The senilely deteriorated who have reverted to a condition of total dependency.
- (5) The incurably mentally ill, for whom, by all measurements, mental anguish is unbearable and intractable.
- (6) All incurably mentally ill.
- (7) The institutionalized mentally retarded.
- (8) The paralyzed, blind, deaf, or impotent.

Euthanasia might be made available (1) to those who seek it for themselves (i.e. Voluntary Euthanasia), (2) to those families who seek it for a relative. It might be administered unasked, to those for whom society agrees it would be a blessing or even to those who, in society's view, place an unnecessary burden on the healthy and fit. Obviously euthanasia can have very different

proportions depending upon its object, i.e., whether it seeks to relieve the patient's pain, the family's distress or society's burden.

The following situation arises frequently in medical practice to-day. An octagenarian with proven carcinomatosis is admitted in what appears to be a terminal state, in great pain and with the most optimistic life expectancy of one week. Morphine may be given to ablate the pain and this by depressing respiration may hasten, although only by a few hours, the inevitable end. With I.V., tube feeding, and vigorous supportive therapy another few hours of agony might be added to such a patient's life but frequently no treatment other than analgesia and sedation is given and the patient is left to die in peace. Some physicians are undoubtedly tempted from compassion to end the undignified spectacle quickly, by a large dose of morphine. How does the physician stand in relationship to the law when he withholds his treatment or when he actively kills in such a case?

The noted English lawyer Granville Williams writes "Under the present law, voluntary euthanasia would, except in certain narrow circumstances, be regarded as suicide in the patient who consents and murder in the doctor who administers, and where patient consent was lacking, murder as well. If the doctor gives the patient a fatal injection with the intention of killing him, and the patient dies in consequence, the doctor is a common murderer. Neither the consent of the patient, nor the extremity of his suffering, nor the imminence of death by natural causes, nor all these factors taken together is a defense". However, no case has been decided where a defense of the above three factors was offered. Mr. Williams speculates that "the judge might direct the jury, that voluntary euthanasia may, in extreme circumstances, be justified under the general doctrine of necessity" which "in common law refers to a choice between competing values, where the ordinary rule has to be departed from in order to avert some great evil". However no hint "of the above possibility" appears in the existing legal authorities. On the contrary, the authorities precisely exclude, on a charge of murder, any such defense.

When analgesics are given for pain, tolerance develops requiring an increasingly larger dose to get the same effect until the dose if given might (although it is very doubtful) in itself be

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## EUTHANASIA

fatal. In this case Mr. Williams opines "a physician may give any amount of drug to deaden the pain, even though he knows that that amount will bring about speedy or indeed immediate death. The excuse rests upon the doctrine of necessity, there being at this juncture no way of relieving pain. In this limited form the excuse of necessity would be likely to be accepted by a judge, and to this extent it may be held that euthanasia is permitted under existing law. It is doubtful whether a judge would allow an earlier double dose to reduce the time of numb, miserable and hopeless existence. The law is also probably adverse where the physician, in order to end his patient's suffering, departs altogether outside any treatment that has been previously given. Mercy-killing by omission to use medical means to prolong life is probably lawful. Although a physician is normally under a duty to use reasonable care to conserve his patient's life, he is probably exempted from that duty if life has become a burden to the patient". (2) Mr. Williams points out that it would, in practice, be very difficult to convict a doctor of murdering through a humane overdose. Assuming the patient to be terminal, was it the overdose or the disease which in fact killed? Determination of the exact killing dose would be difficult. And what, in fact, is the line between a lawfully large dose and an unlawfully large one? It would be unlikely that the authorities would attempt prosecution in such a case, especially if the likelihood of conviction was in doubt. A sympathetic jury might find a defendant "not guilty" on a technicality or even possibly contrary to the judge's direction of "guilty" of murder. And even if the physician were convicted, governmental response to a plea of clemency would likely reduce the penalty. One actual case that closely approached the issues involved was *New Hampshire vs. Dr. Sander* (1949) where the physician recorded in the chart that he had injected 40 cc. of air into a vein of his cancer-ridden patient who died 10 minutes thereafter. He was acquitted on the ground that insufficient proof was offered that the air in fact had killed. A number of other cases are recorded where relatives of the deceased have killed in mercy. Some of the defendants have been hung, others imprisoned and others acquitted. Thought provoking is the statement of Justice Branson in an English murder case of 1927 where the father drowned his incurably tuberculous child. When the jury returned a verdict of "not guilty" the Justice, among other things, said "Had the poor child been an animal instead of a human being so far from there being anything blameworthy in the man's action

he would actually have been liable to punishment if he had not done so". (3)

On the subject of monsters Granville Williams writes "There has been no modern work or any court judgment on the legal rights of monsters". One must go back to Bracton in the reign of Henry III of England for legal authority. He states monsters are not human beings. Blackstone, in his commentaries concurs, but apparently under the impression that monsters are the result of animal parentage. Mr. Williams states that "a creature that is clearly a monster in the old fashioned sense could lawfully be put to a merciful death". (2) In reviewing what application the law has to the example cited above, it is apparent that we have found a legal hiatus, for whatever is the present practice of euthanasia, legal or illegal, in terminal patients or monsters, these problems are not getting to court.

That a hiatus exists is attested to by two attempts to gain legislation to legalize euthanasia. In 1936 a bill was introduced into the House of Lords by supporters of the British Euthanasia Legalization Society who counted in their number such men as Sir James Jeans, Julien Huxley and George Bernard Shaw. The bill provided for legal voluntary euthanasia for adults suffering incurable, painful diseases, under strict safeguards. It was debated for one day and postponed indefinitely.

A petition for legislation sent to the New York State Legislature in 1939 bore the signatures of 1776 doctors and 379 Protestant and Jewish ministers. They sought euthanasia for those in terminal suffering, the hopelessly insane, the feeble minded, the incurably ill and defective infants. No legislation was drafted in response. (4)

The Penal Codes of some other countries have partly avoided this problem by allowing less severe penalties for killings done with humane motives. The German Federal Republic recognizes "Homicide on request" (of the deceased), the penalty being moderate imprisonment only. Switzerland allows the sentence to be reduced if the motives for killing are good, as does Norway and Russia. In Uruguay euthanasia on request is without penalty. (5)

Aside from the legal problem euthanasia is concerned with great moral issues. Consequently organized religion is inextricably involved. A Jewish view is expressed by Emanuel Rockman, President of the New York board of Rabbis. "Jewish ethics prohibit suicide—without exception and also euthanasia—without exception. Confronted with a suffering fellow man the doctor or family must steer between the inviolability of the right to life and the command to

mitigate suffering. Whatever the decision there will be no punishment by human tribunals — according to Judaism. Mercy killing will not be murder. The freedom to act morally is therefore absolute. One acts only under God and with one's own conscience as one's guide. And one will have to live with that decision forever after. The law however plays no part". (6)

Reverend J.D. Hasset of Fordham University, a Roman Catholic, writes: The argument moves from the basic belief "that there is a God; that He has brought us into life; that having done so He sustains us in that life and will in His good time, call us from it. In this tradition the most radical and sacred right a person possesses is his right to life. And no human being or human institution has the right directly or deliberately to take the life of an innocent person. The fact that a person voluntarily gives his consent to be killed does not change the basic nature of homicide. They are not only morally evil actions of the individual but they also are crimes against society since they go counter to the state's obligation to preserve human life. The direct and deliberate taking of a life of a person even if he is incurable is not to eliminate or alleviate suffering...it is to eliminate his life. Man does not have dominion over his life, just the use of it. This use to be perfective and moral must be according to God's law", which forbids euthanasia as being seriously immoral. On killing in a different context he writes "No human being or human institution has the right to take the life of a human being directly and deliberately, unless the latter is an unjust aggressor against the individual or the common good. You may defend your life and your property and if in doing so you kill your aggressor you are not morally wrong. Self defense is not aimed at destroying life but at preserving it. That the state acting officially has the right to employ capital punishment is defensible morally on the grounds that this method is deemed necessary in a given historical situation (1) to restrain malefactors from crimes which would be against the very lives of its members or seriously imperil the common good or (2) by way of retribution for serious violations of the social order. A nation fighting a just war has the right to authorize its members to kill the enemy. The enemy is an unjust aggressor attacking the lives and/or common good of the innocent nation". (6)

Several Protestant views differ fundamentally. Paul Ramsey, professor of Religion at Princeton feels that in terminal suffering voluntary euthanasia is morally justified insofar as the patient is concerned but he is not so sure about the moral-

ity of the physician's position in this. He feels that a doctor is morally justified in withholding treatment. In 1936, Dr. W.R. Inge, Dean of St. Paul's Cathedral, in support of euthanasia legislation wrote: "I do not think God wills the prolongation of torture for the benefit of the soul of the sufferer". (7) In contrast the General Convention of the Protestant Episcopal Church of America in 1952 came out against euthanasia in any form. (2)

A multitude of secular opinions and arguments, both pro and con have been advanced. It is inhuman to save, when an overwhelming infection would offer, but for antibiotics, a quick, humane and dignified alternative to protracted suffering of patient and family. Euthanasia contravenes the generally held belief that life is sacred and any infringement of this concept's domain is likely to be resisted especially in view of the recent popularly supported movements to rescind the death penalty.

We justify war and capital punishment, both perpetrated for the worst motives. How can we fail to justify euthanasia, a practice with the best motives? By allowing any form of premeditated killing we tacitly acknowledge the right of one man to kill another. Such an admission would seriously weaken our whole system of law and order. If we legalize euthanasia for the physician the general public would be encouraged to practise it also under circumstances where no doctor was available. All they would be guilty of in such a case, is practising medicine without a licence.

How can one conceive of a merciful God wishing one to fight to prolong pain with no hope of prolonging life? Euthanasia is against the biblical command "Thou shalt not kill". Yet do unto others as you would have them do unto you?

Cancer is most frequently the villain in the incurable patient in pain. Over 200,000 people die each year of cancer in North America. Contrary to popular opinion most terminal patients with cancer die in relatively painless oblivion. Pain is a subjective sensation. Is the mental pain of the incurably insane any less real than that of the cancer victim? How can you tell who is in sufficient pain to need euthanasia?

The advance of medical science owes no small amount to the medical profession's refusal to accept the stamp of failure, "incurable". By killing some of our incurable we would sap our ardour to seek cure.

Doctors can err in prognosis. There is always the rare possibility of recovery. The prognosis with euthanasia is 100 per cent.

You don't abandon a valuable operation just because it can be done in error on occasion.

## EUTHANASIA

If you start killing those in pain who wish death, next you kill all those dying in pain. It is then a short step to killing the defectives, then who knows what other "inferior" or "undesirable" minorities.

The thin edge of the wedge argument can be used against any good reform by extrapolating it to a ridiculous and obviously undesirable conclusion. Any value in free hospitalization for the poor can be denied with this argument by painting the irrevocable conclusion of such an idea as tantamount to total state control. Anything is good only within strict boundaries—the same is true of euthanasia.

When there are so many healthy intelligent people starving and illiterate in the world, how are we justified in maintaining large vegetable gardens or dragging out the last painful days of a man willing to die? In a survey conducted in 1920, 73 per cent of parents with defective children favoured their extermination. (5)

The final drug induced sleep of the terminal case is, for all practical purposes, death. We therefore in everything but name now practise euthanasia. Why not legalize what is now presently accepted?

These propositions and many more form the tangled jungle that is the problem of legalized euthanasia. The espousal or rejection is a matter of personal opinion, logic is not enough. The ultimate disposition of all this may likely depend on forcing circumstances not yet in existence, for example, the future over-crowding of the planet

making extinction of the unfit a necessity. As things now stand we have been placed in an impossible position. In response to the pleas of the patient or his relatives and out of human compassion we may be tempted to intervene, thereby running the danger of a murder charge. The alternative is to turn one's back on extreme human suffering. The situation is intolerable. But it is not our responsibility to solve what is obviously a great moral issue which society as a whole must face and resolve. Recognizing the problem is half way toward solving it. In this at least we can act.

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- (6) New York University Law Review 31: Nov. 56.
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**ABSTRACT:** General Hypothermia for Managing GI Hemorrhage: *G.F. Gowen and W.W. Lindenmuth*: J.A.M.A.; Jan. 7, 1961.

A report is given of three cases of massive GI bleeding in which total body hypothermia was used to control the bleeding when operative intervention was considered unsafe. It is known that hypothermia protects against tissue anoxia, and also that the survival time of experimental animals from hemorrhagic shock is greatly increased if treated with hypothermia and chlorpromazine.

The method consisted of administering chlorothiazide, promethazine, and barbiturates in amounts sufficient to control shivering and induce sleep. Ice bags were applied to inguinal and axillary regions. The body temperature was monitored continuously and kept at a level between 30 and 32°C. Cardiac activity was monitored with a cardioscope, and IV fluids administered. The hypothermia was maintained for four days by these means. In all three cases the hemorrhage stopped. Rewarming was com-

menced 24 hours after the cessation of all bleeding. In no instance did the hemorrhage recur.

**ABSTRACT:** The Rubella Problem: *C.W. Skinner*: American Journal of Diseases of Children, Vol. 101, Jan. 1961, pp. 78-86.

The rubella syndrome consists of the complications of pregnancy (spontaneous abortion and stillbirth) and congenital defects occurring alone or in combination, namely eye defects, congenital heart disease, dental defects, microcephaly, mental retardation, deafness, and failure to thrive. Congenital defects have been documented in approximately 9-12% of infants whose mothers contracted rubella in the first trimester. In spite of maternal immunity, the fetus may still be attacked by the virus. Rubella may be a difficult diagnostic problem and although prophylactic inducement of the disease, passive immunity and therapeutic abortion are available for the prevention of the rubella syndrome, none is completely effective or safe.

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*This paper received the Charles E. Frosst Scholarship in Medicine (\$500) "awarded to the final year medical student, who having placed among the first 10 in the previous 3 years, submits the best essay on a prescribed subject chosen by the Company". This year the subject was, "Drugs which affect reabsorption from the renal tubule".*

Ever since Claude Bernard presented his famous hypothesis of "Milieu interieur" the physiologist, pharmacologist and clinician alike have become increasingly more interested in the important role of the kidney in the regulation of water, electrolyte and acid-base balance of the body. Numerous disease syndromes are now known to be associated with alterations in the delicate renal regulatory mechanisms most commonly with abnormal salt and water retention. Compounds that block renal tubular reabsorption of salt and water reverse this process and improve symptoms associated with these syndromes.

## PHYSIOLOGY OF TUBULAR REABSORPTION

Drugs affect tubular reabsorption by inhibiting, potentiating or otherwise altering basic normal physiological processes.

The nephron is the functional unit of the kidney. It consists of the glomerulus and its accompanying tubule. The tubule is subdivided on both anatomical and histological grounds into the proximal convoluted tubule, the loop of Henle, and the distal convoluted tubule. The glomerular filtrate is an ultrafiltrate of all constituents of the plasma that are in free crystalloid form and can pass through a semi-permeable membrane.

In the proximal convoluted tubule the nutritional or threshold substances such as glucose, amino acids and vitamin C, are completely or almost completely removed by active chemical reabsorption by the tubular cells, aided by enzyme systems such as a phosphorylating enzyme, phosphatases, activated CoA complex, and probably many as yet unknown mechanisms. About 87.5 per cent of the water in the filtrate along with a quantity of Na and Cl and other electrolytes (K, HCO<sub>3</sub>, Mg, Ca, Phosphate) sufficient to leave the modified filtrate virtually isotonic is also reabsorbed in the proximal tubule. It is now generally agreed (1) that reabsorption of Na (or Cl) is the primary

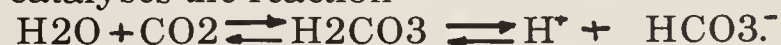
motivating force for the iso-osmotic obligatory water reabsorption. The proximal tubules apparently have some enzyme system(s) which cause rapid transport of these ions from the tubular lumen to the peritubular capillaries. One such enzyme known to exist is the "SH-activated enzyme", which seems to be concerned with the reabsorption of chloride.

In the *distal tubule* the quantity of water reabsorbed is dependent in normal circumstances on the quantity of ADH liberated by the neurohypophysis.

Like the reabsorption of water in the distal segment, the reabsorption of sodium in this region is facultative. However there the two absorptions are independent of each other. At least a portion of the sodium reabsorption depends on the degree of stimulation of the tubular cells by the adrenocortical hormone aldosterone. The mechanisms involved here are far from clear.

There is another type of reabsorption of sodium which takes place in the distal segment. This is the reabsorption of sodium along with other cations as the bicarbonate when these bases are exchanged for hydrogen and ammonium ions (and K) in the acid base regulating mechanism of the kidney. In severe acidosis, for example, acidification of the urine is brought about by the reabsorption of the base of salts of organic acids or of dibasic phosphates leaving them in the form of free acids, ammonium salts or of monobasic phosphate.

The source of the H<sup>+</sup> is based on the dissociation of carbonic acid formed in the distal tubular cells where the enzyme carbonic anhydrase catalyses the reaction —



The renal ammonia is formed in the distal tubular cells from the action of glutaminase (60 per cent) and deaminases (40 per cent), stimulated, it is believed, (2) by ACH liberated in response to acidosis.

Tubular resorption is the sum total of many processes, some obligatory, dependent on the "laws" of isosmolarity, and others facultative, dependent on the action of many enzyme systems, most of which are little known and still less understood.

## DIURETICS

Diuretics can be defined loosely as all com-

pounds that cause a net increase in the volume of urine elaborated per unit time.

#### *Osmotic Diuretic Agents*

These are compounds that are filtered by the glomeruli, are poorly reabsorbed by the tubules, and consequently inhibit the reabsorption of an osmolar equivalent of water. The hexahydric alcohol, mannitol, is a classical example of such a compound. This agent is ultrafiltered completely at the glomeruli and is not reabsorbed. Water is thus osmotically withheld from reabsorption as it passes down the tubule lumen.

Actually, all diuretic agents except water act basically like mannitol, except, whereas mannitol provides its own filtered solute to withhold water osmotically, most other agents act in whole or part by inhibiting electrolyte reabsorption in order to accomplish impedance of the iso-osmolar back diffusion of water. The mechanism of other agents diverge beyond this point.

Many other compounds have been employed as osmotic diuretics, among which are urea, primarily of historical and experimental interest only, and ammonium chloride.

Salts such as ammonium chloride which produce acidosis seem to have an action greater than would be expected from their osmotic effect (3) and oblige consideration of their acid-forming properties in the mechanism of the diuresis they produce. Also, as a result of the acidosis produced, renal mechanisms already referred to come into play. Chloride is excreted as the ammonium salt and the cation resorbed. When full compensation is achieved after a latent period of a few days, the amount of  $\text{NH}_4\text{Cl}$  excreted by the kidney will be equal to that ingested. Once this balance occurs  $\text{NH}_4\text{Cl}$  will no longer be effective. For this reason  $\text{NH}_4\text{Cl}$  is now more frequently employed as interim therapy along with organomercurials, which are more effective under conditions of moderate acidosis as will be discussed later.

#### *Xanthine Diuretics*

Until recently these drugs—caffeine, theophylline, theobromine, having the basic structure of 2,6 dioxypurine where among the most generally used and least understood of all diuretics. Theophylline combined with ethylene diamine was most frequently employed (aminophylline).

In the early literature their diuretic action was thought to be due to an increased glomerular filtration rate based on their cardiotropic effect of renal hemodynamics. In 1921, Cushny and Lambie (4) showed that a diuretic response occurs to these drugs in the absence of any change in filtration rate. Actually their primary diuretic action is to inhibit renal tubular reabsorption of  $\text{Na}$  and  $\text{Cl}$ , (5) but the mode of action is not well understood.

These compounds have a relatively low order of potency.

#### *Pyrimidinediones or Aminouracil Derivatives*

A discussion of these compounds logically follows that of Xanthines to which they are comparable in action and potency. Two compounds of clinical importance are aminometradine (Mictine) and amisometradine (Rolicton). These drugs are believed to diminish the tubular reabsorption of sodium and chloride ions without necessarily influencing renal hemodynamics. The incidence of G.I. complaints plus their relative impotence have decreased their use.

#### *Triazines*

In 1944, a group of drugs belonging to this class were reported as potent diuretic agents in the rat (6). To date the triazines most studied in man influence water excretion more than salt, their order of activity is moderate and they tend to induce G.I. complaints. The induced nitrogen retention portends a more generalized renotropic effect.

#### *Organo Mercurials*

The primary action of this group is to depress the tubular mechanisms responsible for active reabsorptive transport of certain ions. It is believed these drugs inhibit the "SH-activated enzyme" systems in the proximal tubule thought to be essential for providing energy for renal tubular transport or direct carriers of ions. The mechanism of action is presumably by the formation of inactive mercaptide complexes. That the diuretic action can be completely inhibited by certain mercaptans (eg. B.A.L.) provides strong evidence to this theory.

Specifically, these drugs appear to block the reabsorption of the chloride ion in the proximal tubule. Thus, chloride is the predominant ion in the urine. The natriuresis is merely a consequence of the necessity for the excretion of equal numbers of cations and anions. (This is still a controversial point. Pitts (7) believes  $\text{Na}$  reabsorption active,  $\text{Cl}$  passive.)  $\text{H}$  transport and  $\text{HCO}_3$  reabsorption are not affected. Since the chloride loss is greater than the  $\text{HCO}_3$  a tendency to hypochloremic alkalosis develops with the use of these drugs.

These drugs also depress the tubular secretory transport of potassium which is now believed to be the chief mechanism for the excretion of this ion. However the excess chloride excreted is accompanied by an increased excretion of fixed cations, a proportion of which is potassium. The net result is variable, but usually no potassium disturbances arise in clinical use.

Acid salts potentiate the action of these drugs and alkalyzing salts exert no such effect. Moreover, a patient who develops an alkalosis in the course of mercurial treatment may become refractory to further therapy. The explanation for

## DRUGS AFFECTING TUBULAR REABSORPTION

this is quite logical (7). Mercury specifically decreases chloride reabsorption. Therefore the diuresis obtained will be proportional to the amount of chloride being presented to the tubules per unit time. If this were low, the capacity of the tubule to reabsorb chloride would not be exceeded by the load, even though the transport capacity was reduced by the drug. The greater the chloride load the greater the diuresis for a given degree of depression of transport capacity.

It is important to realize that the chloride load is the product of plasma chloride level  $\times$  filtration rate. Patients in advanced cardiac failure may have such low filtration rates that they are unresponsive. A filtration rate less than 50 per cent of normal will give no results.

There are many mercurial preparations on the market for all modes of administration. Most are made in combination with theophylline which aids absorption, increases glomerular filtration rate to some degree, but does not act as a diuretic in doses used.

Many authorities, such as Goodman and Gilman feel that these drugs are contraindicated in renal insufficiency, especially acute nephritis, as the mercury is irritating to the kidney, but the former authors believe that this contraindication need not be adhered to as rigidly as before. They would allow a S.G. of 1.015 or higher as being acceptable for use.

### *Carbonic Anhydrase Inhibitors*

The renal tubules, like the erythrocyte, gastric mucosa, pancreas and portions of the CNS (brain and eye) contain substantial amounts of carbonic anhydrase (CA). This enzyme is responsible for the catalytic reversible hydration of carbon dioxide, which reaction is critical to the uptake and transport of carbon dioxide, by the erythrocyte and its rapid exchange in the parenchyma of the lung. The enzyme is a metalloprotein containing zinc with a molecular weight of about 30,000 (7). The importance of this enzyme to renal physiology was not appreciated until after the advent of sulfonamide chemotherapy. It was noticed that this therapy induced acidosis secondary to an increase in bicarbonate excretion, and it was then further learned that sulfonamides with an unsubstituted sulfamyl group ( $\text{SO}_2\text{NH}_2$ ) in their molecule were capable of inhibiting carbonic anhydrase.

We now know that the important renal functions for conservation of fixed cation, i.e., bicarbonate reabsorption, acidification by the urine buffer system, conversion of ammonia to ammonium—all depend upon exchange of H in the renal tubular cells with Na in the tubular urine. The source of this  $\text{H}^+$  is from the dissociation of carbonic acid. When the rate of formation of this acid is decreased by inhibition of the

carbonic anhydrase enzyme  $\text{H}-\text{Na}$  exchange in the renal tubule (primarily distal but to a lesser extent proximal) (7) proceeds at a greatly reduced rate. As a result, bicarbonate reabsorption is incomplete and the kidney elaborates an increased volume of alkaline urine. Other renal transport mechanisms are unaffected (7). The net result of this highly selective action is loss from the extracellular fluid, via the kidney, of sodium bicarbonate plus an osmotic equivalent of water. The decreased  $\text{H}^+$  secretion leads to an increased  $\text{K}^+$  secretion due to the reciprocal relationship between these two ions. There is essentially no chloruresis.

A common representative drug in this group is acetazolamide (Diamox). A similar drug is Ethoxzolamide (Cardase). The compound induces a metabolic acidosis secondary to the loss of sodium bicarbonate and under such conditions the compound becomes reversibly ineffective, necessitating an intermittent dosage schedule, or the employment of submaximal dosage to obtain sustained effect. This fact, along with its effect on carbonic anhydrase elsewhere in the body probably accounting for the probably accounting for the parasthesia and drowsiness frequently seen, has limited its utility.

Reduction in diuretic efficacy with its continued use no doubt depends on a number of factors (7). When the plasma bicarbonate is reduced, the filtered load decreases. Less bicarbonate is presented to the renal tubules for reabsorption and the demands on the mechanism for exchange of hydrogen ions for sodium are reduced. Therefore, even though the enzymatic production of carbonic acid is reduced, the uncatalyzed rate of formation may be adequate to supply the needed hydrogen ions. A second factor may be stimulation of adrenal cortical activity through a receptor mechanism sensitive to extracellular fluid volume. A third may well be hypokalemia which is known to stimulate the distal tubular mechanism of acidification and ammonia secretion.

### *Chlorothiazide and Related Compounds*

The preponderant renotropic effect characteristic of chlorothiazide is the production of a saluresis, i.e., an increase in sodium and chloride excretion. As the dosage of the compound approaches its maximal effectiveness there is also increased excretion of potassium and bicarbonate, and the urine becomes alkaline. Thus the drug behaves in the manner of an organomercurial with respect to saluresis at low dosage, the more characteristic action of C-A inhibitors becoming evident as the dosage is increased. The important distinction of predominantly chloride elimination rather than bicarbonate as with acetazolamide undoubtedly

accounts for its greater utility, relative lack of refractoriness and a seeming uncertainty with regard to its mode of action (8). Another characteristic which distinguishes it from the other two groups is its persistence of action in acidosis or alkalosis. B.A.L. has no effect in chlorothiazide saluresis, further distinguishing it from the mercurials.

The fact that chlorothiazide increases both the excretion of sodium and, to a lesser extent, potassium distinguishes it from aldosterone antagonists which induce a naturesis without evoking a kaliuresis. There is no evidence of adrenal unsufficiency induced by the drug. The drug is not a true antagonist to the posterior pituitary antidiuretic principle (9). The drug is essentially as active when absorbed orally as intravenously. In general, the distribution of the drug is in the E.C.F. which probably explains the lack of side effects seen with the more widely distributed carbonic anhydrase inhibitors. The toxicity is very low—potassium depletion and some nitrogen retention being mentioned in the literature.

Pitt (10) has suggested, in respect to chlorothiazide and organomercurials, that there is but a single mechanism of sodium reabsorption with multiple sources of energy and each block separate sources, other sources remaining resistant to them both. In respect to chlorothiazide and carbonic anhydrase inhibitors he concludes that both block common mechanisms of bicarbonate reabsorption and acidification, and facilitate a common mechanism of potassium secretion; in these actions, acetazolamide is the more potent drug.

Ford and Rochelle (11) conclude that the mechanism of action of chlorothiazide is competitive with that of the mercurials and the C-A inhibitors, yet chlorothiazide can act through another mechanism which is non-competitive with either mercurials or the C-A inhibitors. No other mechanisms are available to these latter two drugs.

They further conclude that this additional mechanism of action of chlorothiazide may imply involvement of another enzyme system or it may imply a greater range of activity of chlorothiazide throughout the nephron.

Hydrochlorothiazide, recently introduced, is said to have at least a tenfold greater order of saluretic activity as represented by dosage as chlorothiazide. Interestingly enough, hydrochlorothiazide is only 1/10 as potent as chlorothiazide in its *in vitro* C-A inhibiting properties. Flumethiazide and hydroflumethiazide have been reported to be slightly less active than their chloro analogues.

#### *Anti aldosterones*

The effects of the adrenal cortical hormone,

aldosterone on the kidney tubule may be said to be a decreased excretion of sodium and an increased elimination of potassium. The factors controlling the secretion of this hormone are very complex and not fully understood, but we may say that its secretion is increased by salt deprivation, excess potassium intake or reduction in extracellular fluid. The increasing evidence of the physiological importance of increased aldosterone production in edema of heart failure or cirrhosis has made it attractive to search for antagonists as potential diuretic agents. The two approaches to this problem have been to (a) inhibit adrenal cortical secretion and (b) antagonize its effect at the tubular level.

Amphenone B has been shown to depress the secretion of aldosterone. Unfortunately the toxicity of this drug is such as to discourage its use. Certain synthetic steroid spirolactones antagonize the action of DOCA with respect to both sodium conservation and potassium loss. Presumably these drugs act by competing with aldosterone and displacing it from receptor sites in the distal tubular cells. The response to this therapy has been modest usually, although they have shown a marked synergistic effect with chlorothiazide, and even more so with prednisone added. Quantitatively the spirolactones are slower to act and not nearly as potent as the mercurial or chlorothiazide groups in promoting Na and H<sub>2</sub>O diuresis. However, qualitatively they are unique in not increasing K excretion. A commercial preparation, Aldolactone, appears to have its most beneficial effects in the intractable ascites of cirrhosis.

There are many conceivable mechanisms by which tubular reabsorption could be depressed. The least specific of these would be to interfere with reactions which supply energy for transportation. A drug which does this is dinitrophenol. This drug blocks the generation of energy rich phosphatases and thus decreases tubular resorptive capacity.

More specifically drugs can competitively inhibit the complexes involved in transport of substances. Such a drug is probenecid. This drug is a benzoic acid derivative. This drug decreases the tubular reabsorption of urate and decreases the tubular excretion of penicillin and P.A.S. The mechanism here is not fully understood. It is known that the drug inhibits the conjugation of glycine and benzoic acid by competing with benzoate in the activation reaction,

$\text{Benzoate} + \text{Co} + \text{ATP} \rightarrow \text{Benzoyl CoA} + \text{ADP} + \text{P}$   
It is hypothesised (3) that the CoA is the intermediate compound in the renal transport of these substances — urates from the lumen through the cells into the blood stream, and the other substances in the opposite direction (i.e.,

## DRUGS AFFECTING TUBULAR REABSORPTION

the penicillin which is filtered directly is not reabsorbed, the variable being in the amount of penicillin lost through tubular excretion). Probenecid (Benemid) is believed to form a complex with CoA that is less dissociable than that of benzoic acid.

### SUMMARY

The normal physiology of tubular reabsorption is elaborated stressing the importance of activating enzyme systems, many as yet little known or understood, and the role of the carbonic anhydrase enzyme in electrolyte reabsorption and balance. The roles of aldosterone and ADH are noted. A discussion of diuretics is presented with the emphasis on the physiological mechanisms by which these drugs work. The basis of action of most diuretics is the inhibition of electrolyte reabsorption in order to accomplish impedance of the iso-osmolar back diffusion of water. It is in the mechanism by which these drugs accomplish this inhibition that they differ. Of the various diuretics discussed, the mercurials and the chlorothiazides are concluded to be the most valuable to date. The inhibition of renal tubular transport of organic compounds is illustrated by the action of probenecid which decreases tubular reabsorption of urate and tubular excretion of penicillin.

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### Homewood Sanitarium

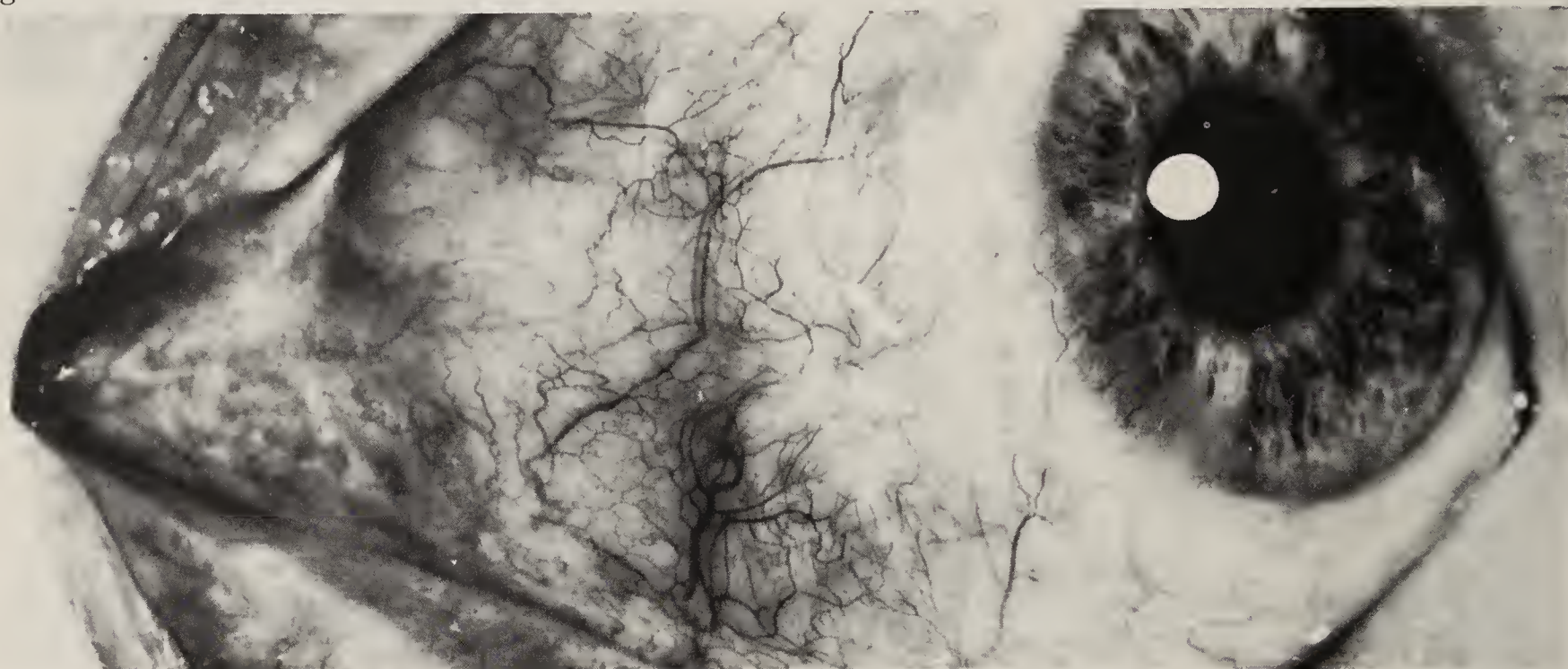
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Fig. 1



Regrowth of blood vessels following Strontium 90 radiation and 2 previous surgical excisions of an intra-epithelioma of the limbus.

The acceleration of progress in medicine as in all sciences is creating many problems, not the least of which is the increasing difficulty for the doctor or scientist to keep abreast and informed of the new advances in his own and related fields. Therefore the illustration, be it photograph or drawing is becoming increasingly important in aiding the rapidity and conciseness with which information may be presented to a reader or listener.

Unfortunately both for doctor and medical illustrator, medical illustration — in particular medical photography — has had a rather curious evolution. It began from the interest of a doctor who was perhaps an amateur photographer. These individuals used to employ an untrained man to assist in the routine work and so was born the medical photographer — an individual untrained and usually uneducated. Medical photographers worth their salt have since tried to raise the status and quality of their work, but have been hampered by the lack of recognized courses of training and selectivity of employees.

## APPLICATIONS OF MEDICAL ILLUSTRATION

Medical illustrations have in general three uses. The two of primary importance are in publication and lecturing. There is also the

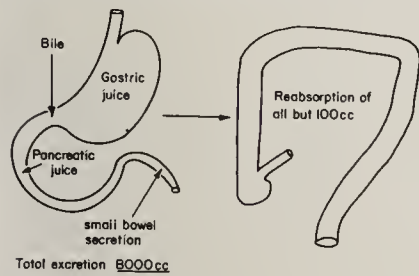
documentary photography within hospitals for the purpose of gathering possible lecturing material and for the purpose of demonstrating changes in the disease process. It is the writer's opinion that far too much time is spent in making documentary photographs in hospitals when the department should be devoting far more time to preparing good illustrations for publication.

### *Illustrations for Publication*

There are a few often forgotten points to be considered when preparing illustrations for publication. Before any are considered the journal for which the article is intended should be studied both for the instructions to authors and also for the overall quality of reproduction. If complex illustrations are planned then be sure the standard of illustration in the journal is good enough so that your illustration will be, at least, legible: surprisingly enough the standard of illustration varies enormously from journal to journal. I have seen diagrams and photographs that fail almost entirely to bring their point across merely through lack of planning, poor choice of final size or more often through the failure of the illustrator to realize the salient points of the illustration. By all means let your illustrator in on the secrets; it is his desire to present as clearly as possible the points you wish to make.

Fig. 2

Figure 10 HOMEOSTATIC MECHANISMS  
x FLUID AND ELECTROLYTE EXCHANGE IN G.I. TRACT.



A simple diagram reproduces anywhere.

Perhaps at this point the use of colour may be discussed. The greatest problem with colour illustrations is the cost of publication. Since most of the journals require the author to pay the cost of colour reproduction it must usually be ruled out. Therefore one must find ways of emphasizing in black and white something which seems demonstrable only in colour. One may either be completely diagrammatic in this respect and represent colour by cross hatching, stippling and other graphic art techniques or one may use carefully worked out photographs employing filters to produce adequate colour separation or special films to produce adequate contrast which may be almost as satisfactory as direct colour illustration. Only when it is important to demonstrate the actual colour of a specimen of subject do these methods fail.

#### Illustrations for Lecture

The following points of difference between illustrations prepared for publication and those for lecture are of prime importance. Consider for a moment the technique of slide presentation at a lecture. The lecture is invariably limited in time and the slide remains on the screen for all too short a period. It follows that a slide must be simple, making its points as simply and clearly as possible. all unnecessary legends should be eliminated and the remaining information be presented in a very bold fashion. Colour of course is practical here for photographs, drawings and diagrams. It is invariable an advantage to use colour in a slide even if it doesn't add information, since the existence of colour adds impact. Imagine yourself at an annual meeting (there were 235 annual meetings of medical bodies in the U.S.A. last year). It is the fourth day and nearing the end of the afternoon; you have taken in a lot of papers that

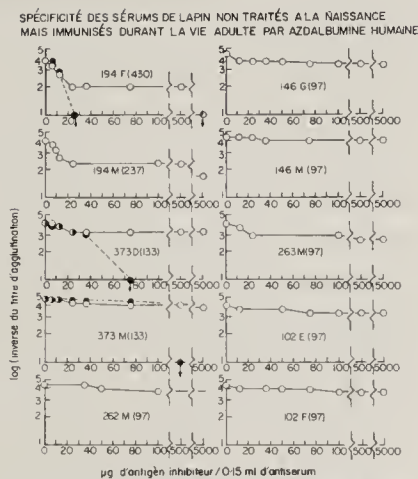


Fig. 5a. Témoin - inhibition par albumine humaine et azalbumine humaine de l'agglutination de globules rouges formés et sensibilisés par azalbumine humaine. Sérum anti-azalbumine humaine obtenu d'un lapin adulte, non traité par azalbumine humaine à la naissance, et des lapins 102E et 102F ayant reçu une seule injection de 5 mg d'azalbumine humaine à la naissance (cette dose n'affecte pas la réponse ultérieure). Les valeurs entre parenthèses donnent l'âge de l'animal, d'après la mise-bas.

○—○ Agglutination inhibée par l'albumine humaine  
●—● Agglutination inhibée par l'azalbumine humaine  
↓ Valeur de l'inverse du titre inférieure à 10

A complex diagram requires the finest reproduction process.

day and have just turned down a game of golf to hear a lecture that you feel will be worth while. Now if that speaker, though not an orator, has a worthwhile set of slides you will come away with the important points of his lecture. If he is a good orator you will come away with an impression of his personality but little of his paper, unless you really concentrated. Good orators are rare. Good slides are becoming more common. The product is sold by the advertisement now, not by the old time huckster.

#### Documentary Clinical Photographs

Photography can be broken down into several well-defined operations, all of which should be standardized and efficiently worked out. There is little place for the creative photograph. Lighting should be simple and used to create effect only for the purpose of demonstrating a specific sign better. A system of exposure and distance settings should be worked out for use according to a predetermined plan so that, for example, all photographed eyes are at the same exposure and distance, thus the magnification is kept constant in series photographs of the same patient.

Fig. 3



Cancer of the right ear before and after treatment.

This greatly simplifies comparison of photographs either in print or slide form. Printing should also be according to a previous system so that magnification is again kept constant. A size standard should be set up for prints, e.g., 3 1/2 x 3 1/2 for all small areas and 6 1/2 x 8 1/2 for all full heads and larger areas. Photographs are mounted on special printed cards and patient's name and number along with the date of the photograph are typed on the card. The photographs are sent to medical records department for insertion in the patient's history. When repeat photographs are required the previous ones can be found either from the file or the patient's history, and the angle and magnification easily duplicated. Photographic negatives and colour transparencies are stored in the

envelope which was originally used as a requisition form and the envelope is filed under the patient's history number or other such system as adopted by the medical records department. There is no justification for the introduction of an arbitrary photographic numerical system since using the same system as the records department is very much more convenient. Such are the handling methods of a department which makes about 10,000 photographs a year.

### BASIC PRINCIPLES

The basic principles of medical photography are twofold. The first principle is that of *simplicity*. A photograph must demonstrate its subject and nothing else. A photograph in the operating room showing staff and instrument trays, etc., is valueless if its primary concern is the operating field. A clinical photograph showing lights and other paraphernalia is a lazy photograph. Lighting technique must be simple. Complex techniques are both time consuming and hard to duplicate.

Fig. 4.



A cluttered useless photograph.

Basal cell carcinoma — right cheek.

Secondly it is imperative that the photographer is sufficiently versed in the photographic science so that the pictures he produces are technically perfect. Since much time is available in a standardized technique for experimentation there is clearly no excuse for second best results.

### THE FIELDS OF APPLICATION

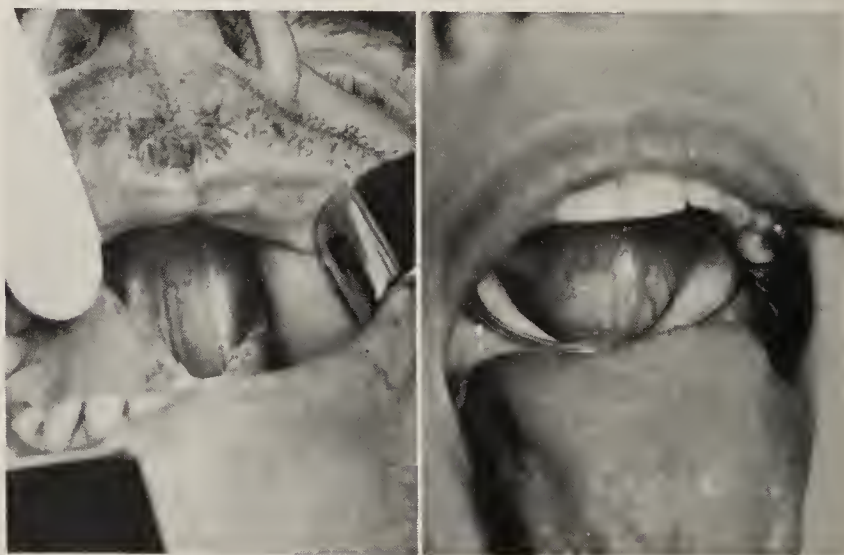
There are six different fields of application of medical photography, each of which requires a special type of technique. These are clinical, surgical and pathological photography, the photography of radiographs, illustrations, and the making of motion pictures. The basic principles above apply to each and in addition there is much that can be said about them individually. Space permits only a few points; medical cinema-

tography, being extremely complex, will not be discussed.

### Clinical Photography

Since it is a common practice in this field to make duplicate colour and black and white exposures, we advocate the use of a single lens reflex camera, preferably of the roll film type such as the Hasselblad. This camera offers many advantages. The interchangeability of film magazines allows successive exposures of colour and black and white. In a fairly fast sequence of photographs, the end of a roll creates little confusion since another magazine can be ready to use on the camera the moment the film is ended. The change takes three seconds. The advantage of film size is apparent. High quality photographs are obtainable with special darkroom techniques that seem to be so essential for good 35 mm. quality. The selection of a fairly slow film such as panatomic X is advisable for the sake of quality and also it can be exposed at the same settings as ektachrome. The use of colour material in this size offers this advantage. We normally cut the 2 1/4 x 2 1/4 transparency down to fit the 2 x 2 mount which gives a projection area of 1 1/2 x 1 1/2 and can be used in a 35 mm. projector, at the same time offering an 84% greater projection area. The reason for cropping from a larger size is to allow for correction of off-vertical and badly centered photographs which occur quite frequently due to subject movement (a fraction of an inch is enough in a photo of the eye). The camera ground glass is marked with a square showing the final transparency size for composition.

Fig. 5



Partially destroyed hard palate.

Oral mirror demonstrates Lingual Thyroid.

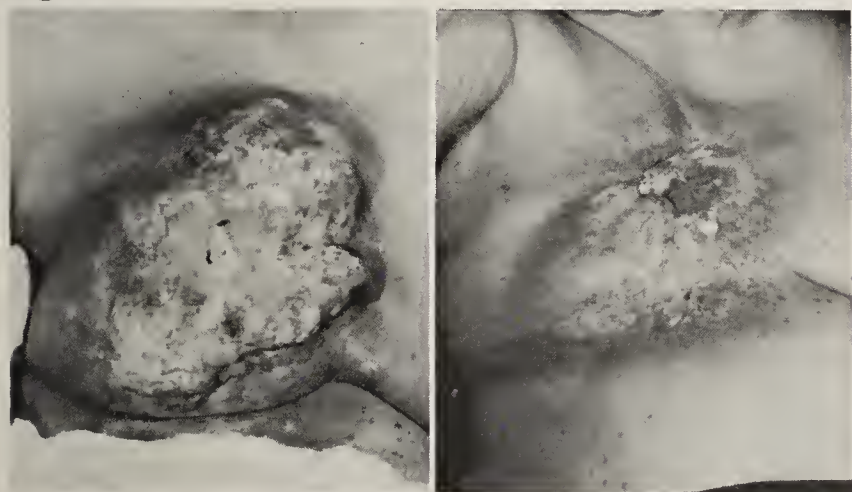
The photography of mouths sometimes presents lighting problems. The use of a circular flash tube round the camera lens is often recom-

mended but this is inclined to give a very flat light and the alternative is to use a single light at the camera lens carefully aimed to light the lesion. The resulting photograph has better contrast and a much greater impression of depth.

Since the use of close-up techniques is common, an exposure compensation factor must be introduced. In such cases the effective f-number is increased in the same proportion as the extension. Using a six centimetre lens extended three cms. past the normal infinity point exposures must be calculated for an f-number one and a half times that to which the stop scale is set. Close-ups of such areas as the eye fundus require special equipment developed for the purpose since the use of any but a pencil beam of light will diffuse the image. Incidentally the publication of identifiable photographs of a patient must be with the patient's permission. It is however a frequent practice to cover the eyes or blank them out in a published photograph in order to prevent possible legal problems.

The demonstration of size in a photograph is accomplished by the use of a scale or ruler. This should be simple, dull surfaced and clearly marked. It is essential that the ruler be the same distance away from the camera as the subject plane being measured. Otherwise perspective will destroy the measurement accuracy.

Fig. 6.



Medullary adenocarcinoma of breast. Note regression after radiotherapy.

## Surgical Photography

The limitations imposed on the photographer in the operating room are considerable and the placement of lights and camera is often largely a matter of compromise. The use of a single flash on the camera and the whole unit on a wheeled tripod of heavy design such as the Linhof studio tripod is very convenient. The unit is steady and mobile and yet takes little space. The best angle is from the surgeons point of view so if possible the photographer should be behind the surgeon ready to swing the

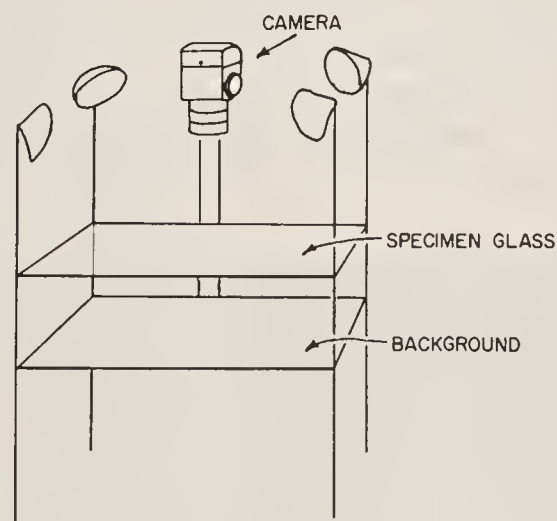
camera in for a photograph. Alternatively the opposite side of the table is almost as good though the photographer cannot expect to have space there throughout an operation.

One can rely on available light only if one is confined to black and white material. The use of electronic flash is advisable for colour photography since the colour balance problem is eliminated. If you wish to use colour and available light then previous tests should be conducted to determine colour balance of the existing light and since this is frequently of the split spectrum type the use of colour correcting filters can only be a compromise.

## Pathological Photography

Pathological organs *in situ* may be photographed in much the same way as the surgical procedures. Organs and specimens otherwise should be photographed on a specially designed apparatus.

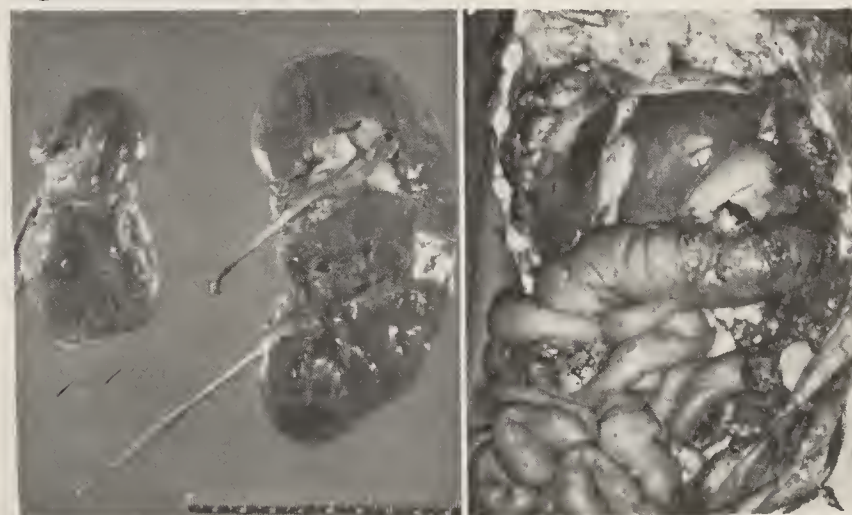
Fig. 7



Pathological specimen apparatus.

This apparatus permits shadowless 3 dimensional lighting effects. The specimen is placed on the glass plate. Four lights on goose neck columns one at each corner are used for illumination and their angle of incidence is about 45°.

Fig. 8



Bilateral double ureters.

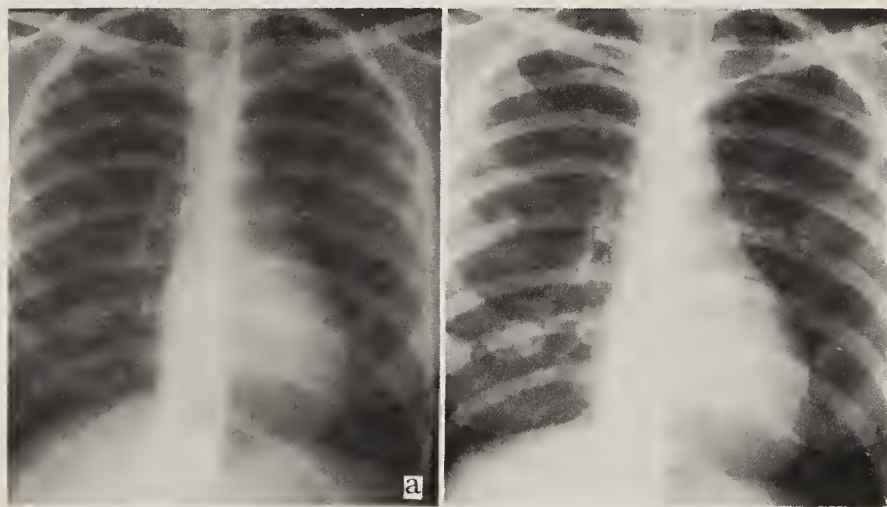
Sarcoma of duodenum with widespread metastases.

This produces a photograph with no shadows on the background at the same time giving sufficient emphasis to the third dimension of the specimen. Polarizing filters may be used to eliminate unwanted highlights. Care must be taken to use reflectors that minimize the amount of light falling on the camera since this may appear as a reflection in the photograph. The use of a longer than normal focal length lens will keep the camera further from the subject and thus reduce this problem.

#### *Photography of Radiographs*

The basic principle in photographing radiographs is that the scale of gradation in the radiograph being very wide indeed must be drastically reduced on the negative, otherwise detail will be lost. The radiograph should be photographed on a light box using a sheet film camera. One successful technique is to use Kodak commercial film or commercial ortho and D.8 developer or DK60a for even less contrast. Development by inspection is essential and perhaps the most difficult phase of the whole technique. Further than this we suggest that experience is useful for only through trial and error can one learn the technique of inspection develop-

Fig. 9



Two photographs of the same chest radiograph.

a. Normal technique.

b. Dodging is used to show chest metastases in chorioepithelioma.

ment and its relationship to the final slide or print. When printing the negative, dodging is of prime importance because with its help an important area may be emphasized by more contrast while other areas, which on this grade of paper would be out of the tonal scale, can be held within the scale by dodging. Dodging is the technique of exposing an area of a print for more or less time than the overall exposure, by interference with the image projected from the enlarger.

#### *Photography of Illustrations*

The photographer who enters the graphic arts field of photography may be much confused by the myriad of film material and developers available. At all times technique should be simple. Even illumination of subject material, rigidity and squareness of camera and flatness of copy material are essential. Two lights are sufficient. A 4 x 5 copy camera on a very rigid stand either in a vertical position for space saving or in a horizontal position is the best compromise of economy and negative size. The fewer film types used the better, since familiarity with a specific film will bring out its versatility. A good selection might be Kodalith ortho for line originals, i.e., illustrations having no halftones. High contrast half tones may be photographed on contrast process pan or ortho and either D8 or DK60a developer used depending on the desired contrast (D8 produces more contrast) and Kodak commercial or commercial ortho for continuous tone normal contrast originals using D8 or DK60a. The ortho and blue sensitive films permit development by inspection. The pan films may be necessary for correct rendition of red in an original.

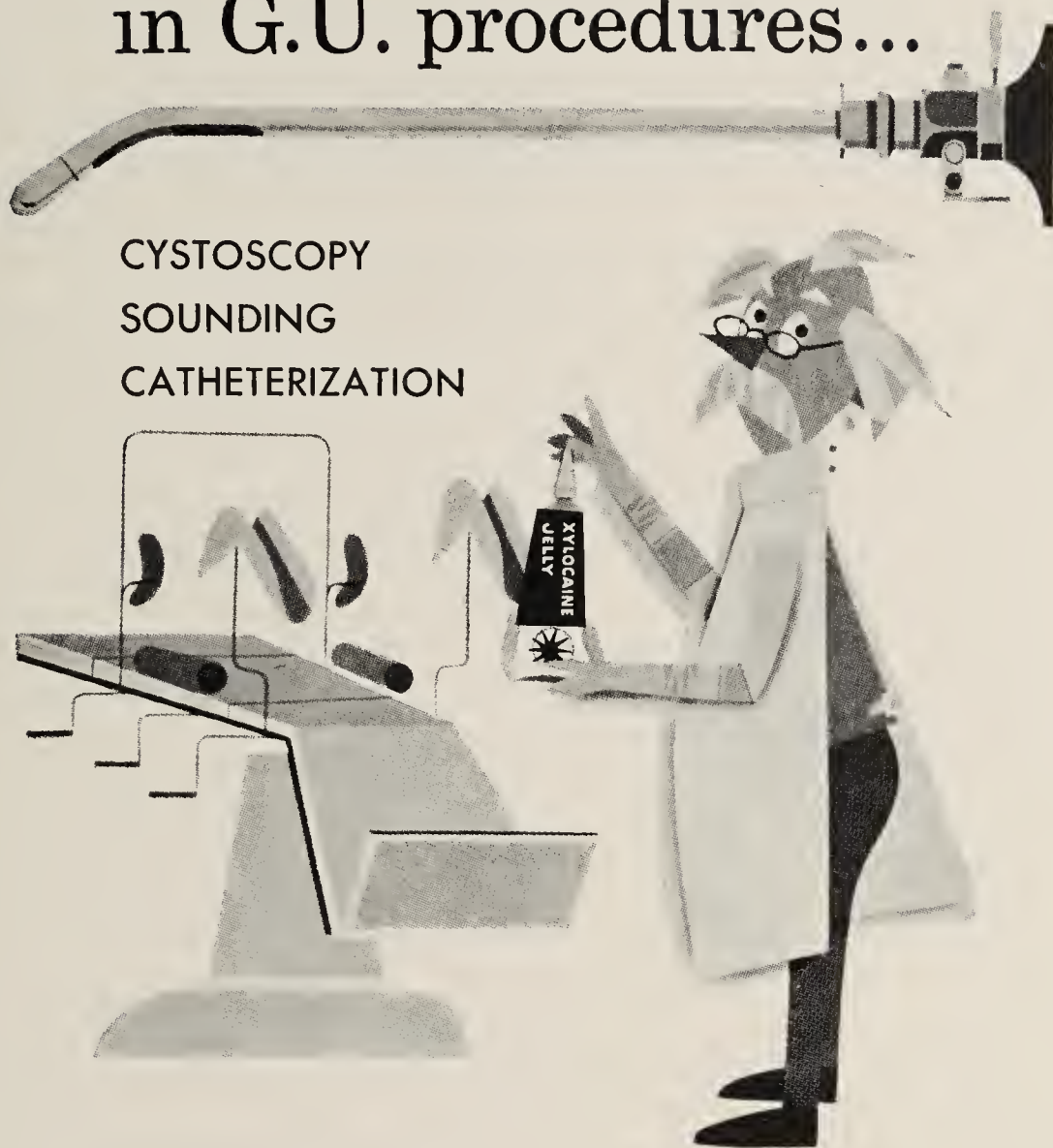
The miscellany of photographs that the medical photographers can expect include everything from portraits of the staff to commercial photos of the equipment and hospital installations. A good medical photographer is versatile!

**ABSTRACTS:** Estimation of Lymph Flow in Extremities: S. Jacobsson and A. Feldman: Archives of Surgery, Vol. 82, Jan. 1961, pp. 97-107.

Radioactive iodinated human serum albumin (RIHSA) is easily detected and measured and, because of its molecular size, only removed from the extravascular space via the lymphatics. RIHSA was injected into the knee joint of dogs and its appearance in the blood and thoracic

lymph and only a little appeared in the blood, which also showed little variation with leg movement. Amounts in the lymph increased with leg movement and remained at a stable level during movement. This method of study may be of value in assessing unilateral lymphedema, lymphatic effects of disease of synovial membranes, and in gaining information about the pore size of lymphatic capillaries by varying the molecular size of injected material.

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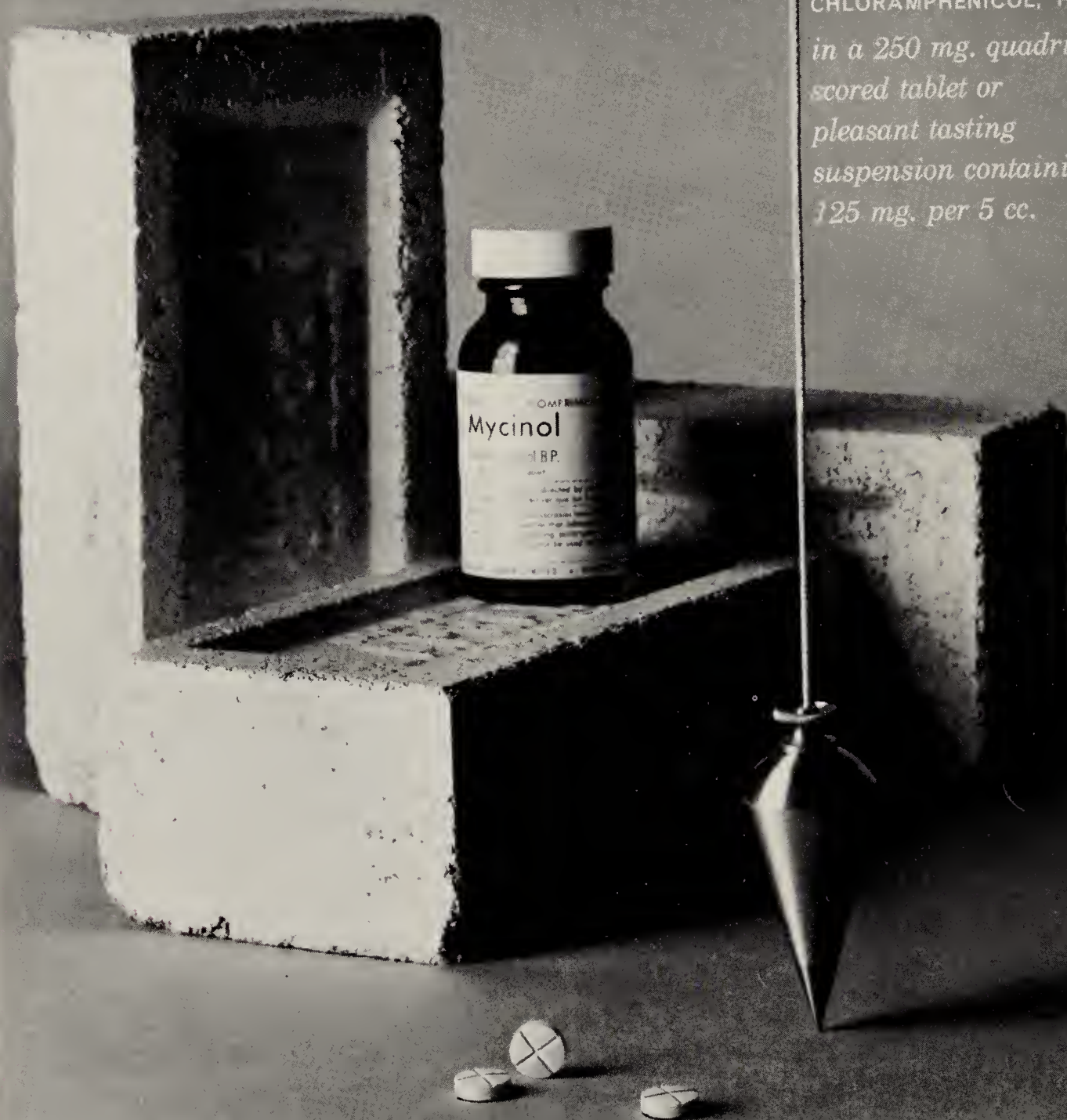
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